ENGINEERING AND MINING JOURNAL

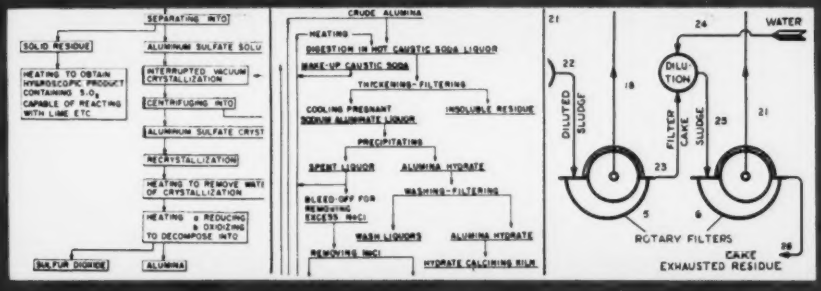
A McGRAW-HILL PUBLICATION

OCTOBER 1961

PRICE ONE DOLLAR

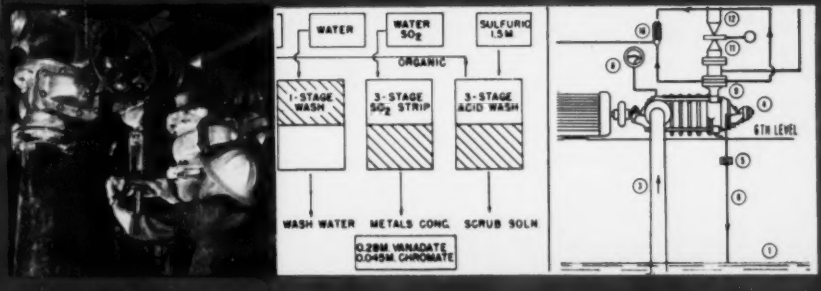
FOUNDED 1866

Aluminum probes new ore technologies



Mining and minerals north of the border

Ion exchange, pumps and pump design



Plus, American Mining Congress at Seattle

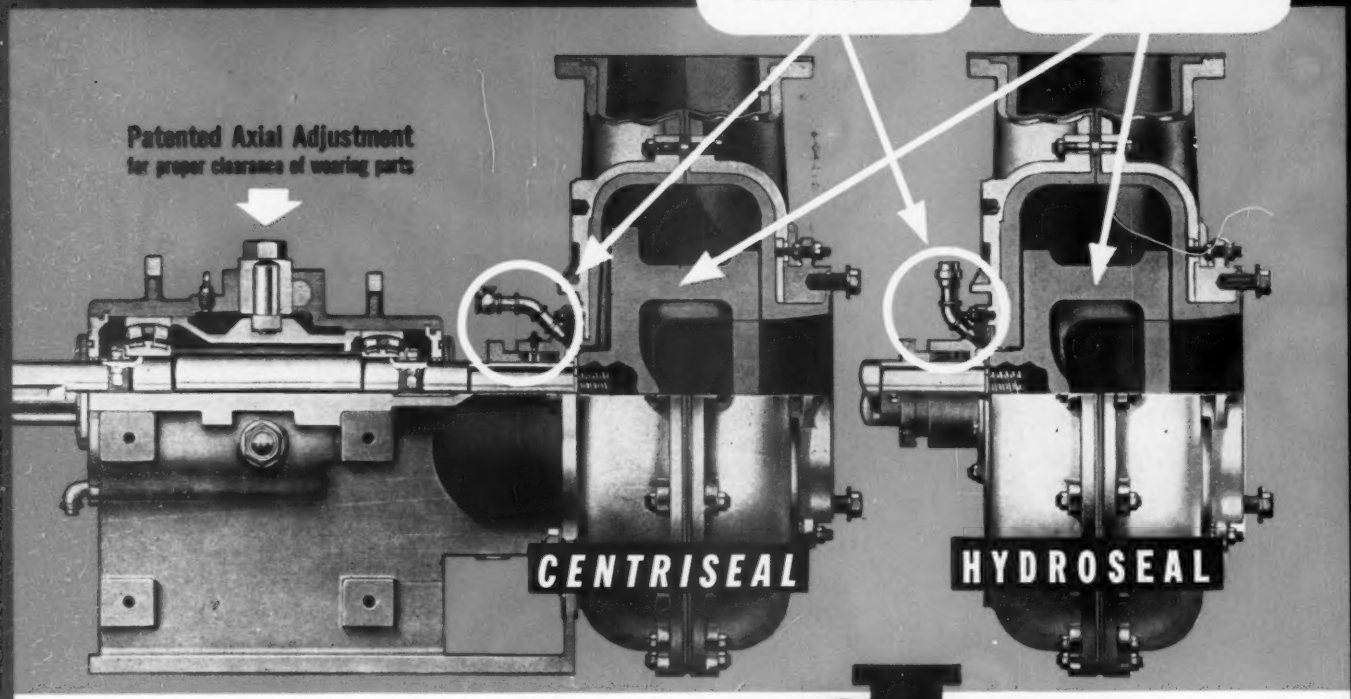
Flexibility helps A-S-H split-shell pumps lick problems in moving abrasives / corrosives

Choices for wetted parts

CARBON STEEL
and/or CAST IRON
HASTELLOY "C"
DURIMET 20
#316 STAINLESS

Choice of MAXIMIX elastomers

NATURAL RUBBER
ACID RUBBER
NEOPRENE
HYPALON
NITRILE
POLYURETHANE
(Cast or Molded)
VITON "A"
BUTYL



Delivers the pulp undiluted. No sealing water.

Operates with sealing water.

This diagram tells why these interchangeable pumps are proving to be so useful in mining and in both metallurgical and chemical processing. Experienced in applying the various metals and elastomers, our engineers may help you improve *your* pumping. Ask us.

THE ALLEN-SHERMAN-HOFF PUMP CO.
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Representatives throughout the World

CENTRISEAL and HYDROSEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED

4½-yard P&H Electrics working at Craigmont Mines Limited's new mine near Merritt, B.C.

IF PURCHASES ARE ENDORSEMENTS...

P&H is the no. 1 choice of the mining industries

In recent years 68% of all American made 4.5 to 9 yard electric mining shovels bought for use throughout the world have been P&H

P&H has earned such widespread acceptance in the mining industries because of lower per-ton loading cost. This profit premium to owners of P&H Electrics results from these two basic advantages:

1. **Higher rate of production** made possible by exclusive, patented P&H design principles of MAGNETORQUE® eddy-current hoist drive and Static Electronic Control. Both of these far-ahead design principles pioneered by Harnischfeger are the direct result of Harnischfeger designing and manufacturing its own electrical equipment—the *only* shovel manufacturer to do so.
2. **Vastly superior service and parts availability** reflecting our partnership of responsibility to you, the buyers of our products—a partnership of responsibility made possible by our *single source control* of electrical as well as mechanical components and their performance.

Your satisfaction with these advantages has made us The *World's Largest Builder of Full-electric Shovels.* Compare before you buy—write for complete information.

HARNISCHFEGER P&H
Milwaukee 46, Wisconsin

61-585

Mining Calendar

Tenth annual Clay Conference, sponsored by Clay Minerals Committee of the National Academy of Sciences, NRC, University of Texas, Austin, Oct. 16-18

International Mining Days, New Mexico Mining Assn., El Paso, Tex., Oct. 15-18

National Safety Congress and Exposition, Mining Section, Pick-Congress Hotel, Chicago, Ill., Oct. 16-19

American Vacuum Society, Eighth Annual Symposium, Washington, D.C., Oct. 16-19

17th National Conference on Industrial Hydraulics, Sherman Hotel, Chicago, Oct. 19-20

The Metallurgical Society, AIME, fall meeting, Hotel Pick-Fort Shelby, Detroit, Mich., Oct. 23-26

Off-the-Record meeting, Pittsburgh section, AIME, Penn-Sheraton Hotel. Concurrent all-day sessions on radioisotopes in mineral industries, petroleum, mining, metals, and open hearth, Nov. 3

Northwest Mining Association Convention, Davenport Hotel, Spokane, Wash., Dec. 2-3, 1961

Symposium on Mechanization of Mines, international meeting and equipment show, Central Mining Research Station, Dhanbad, Bihar, India, Dec. 9-12

Beneficiation and Agglomeration Symposium, 23rd annual symposium of the University of Minnesota, dealing with taconites, pellets and iron ores. U. of Minnesota, Minneapolis 4, Minn. for details. Meeting to be held in Duluth, Jan. 15-17, 1962

AIME annual meeting, New York City, Feb. 18-22, 1962

International Symposium on the Ferroalloy Industry in India, National Metallurgical Laboratory, Jamshedpur-7, India, February 1962

Pacific Southwest Minerals Industry Conference, sponsored by the San Francisco, Nevada and Southern California sections of AIME, Palace Hotel, San Francisco, April 12-14, 1962

American Society for Metals, regional conference and exhibition, Houston, Tex. (Shamrock Hotel), April 17-19, 1962

5th Rock Mechanics Symposium, sponsored by Colorado and Missouri Schools of Mines, Penn State and U. of Minnesota. At U of M, Minneapolis, May 3-5, 1962

Wyoming Mining Assn., annual convention, Jackson Lake Lodge, Wyo., June 8-9, 1962

95th YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

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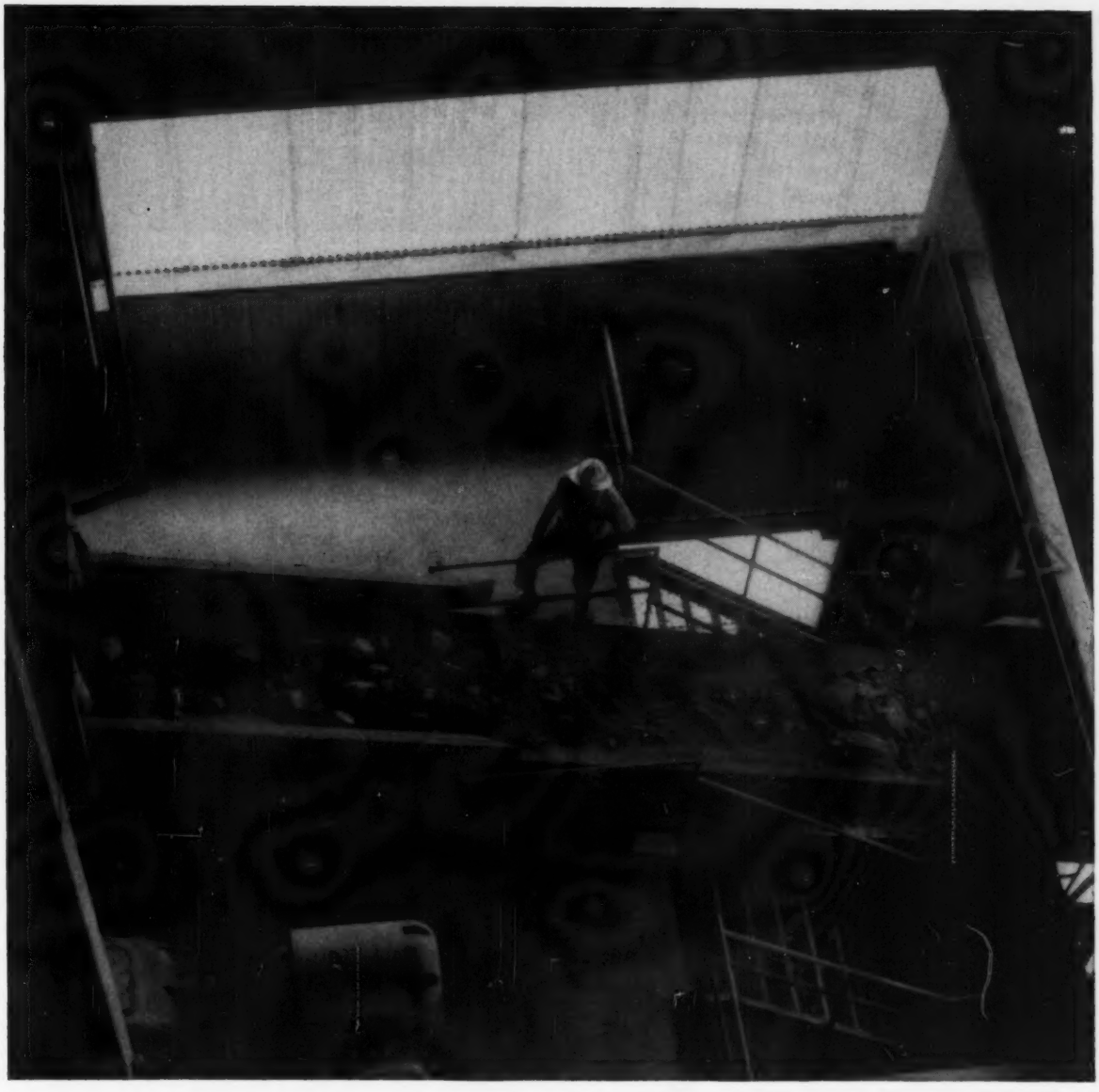

Copper basketballs bounce on rubber

THOSE big chunks of copper ore—some as big around as basketballs—are on their way to be crushed, then crushed again until they're the size of peas. Because 3⅛ tons of material must be moved to produce 16 pounds of usable metal, the ore must be handled at low cost.

That's why an impressive conveyor system was installed last year at Kennecott Copper's Ray Mines Division in Arizona. It's designed to handle enough ore to permit extraction of 60,000 tons of copper a year. When it came to selecting the belts, the one in the picture got special attention. It not only has to bear the brunt of the uncrushed material, but it must cope with an occasional pick, tamper bar or shovel tooth mixed in with the ore as it comes from the mine.

B.F.Goodrich engineers recommended that the rubber belt be made with BFG Nyfil fabric. Nylon used for cross threads in the fabric adds extra strength to the belt so it resists heavy impact, stands wear and tear that cause other belts to break down.

Result? In its first year and a half on the job, the B.F.Goodrich belt has moved more than 3 million tons of chunky ore, and is still going strong.

Your B.F.Goodrich distributor has full information about this Nyfil belt. And, as a factory-trained specialist in rubber products, he can answer your questions about any of the rubber products BFG makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-155, Akron 18, Ohio.*

B.F.Goodrich

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ENGINEERING AND MINING JOURNAL

Continued from p 2

105 Aluminum Probes New Processes and Ore Sources

During the past few years, aluminum laboratory and pilot-plant research have centered about the two processes which, if successful, could completely alter the direction and scope of the entire industry—direct reduction of aluminum, and extraction of high-grade alumina from materials other than bauxite. Investigations into direct reduction have progressed far enough for Aluminium Ltd. to announce that its $4-million Arvida, Que., plant will begin commercial testing at the end of this year or early in 1962. A year's test run at the 6000-8000-ton capacity pilot plant will show Aluminum just how long it will take to begin commercial production.

The other research project—extracting alumina from clays, phosphates and shales—is being undertaken by several of the larger aluminum companies. One of these, Olin Mathieson Chemical Corp., is perfecting a process which will extract alumina from, among other things, the overburden of shale removed during certain coal mining operations. These and several other of the more pertinent aluminum technological innovations are described in a report beginning on p 105.

90 Mineral Activity North of the 49th Parallel

Dick Lund, of Battelle Memorial Institute, offers a penetrating study of the present and most promising non-fuel mining operations in northwest North America. Mr. Lund includes a map of the major mining sites and offers one of the most complete compilations of working properties in Alaska and Western Canada that we've seen.

Eastern Canada is represented in this issue with the full story of the St. Lawrence Columbium & Metals property, which is operating "within sight of the evening city lights of Montreal." The mine, its story and a detailed pyrochlore flowsheet can be found on p 99-104.

110 Ion Exchange, Pump Design and Valve Replacement

Three authors from the Chemical Research Department of General Mills, Inc., have combined to tell the story of a liquid ion exchange reagent capable of extracting metallic anions from both acidic and alkaline media. They offer charts and a flowsheet describing the process as applied to a vanadium-chromium recovery technique.

Successful installation of an underground pump station, complete with precise controls and monitoring devices is described in an account of the installation at "Sachtleben" in Germany. Drawings and a full description of how's and why's appear on pp 93-96.

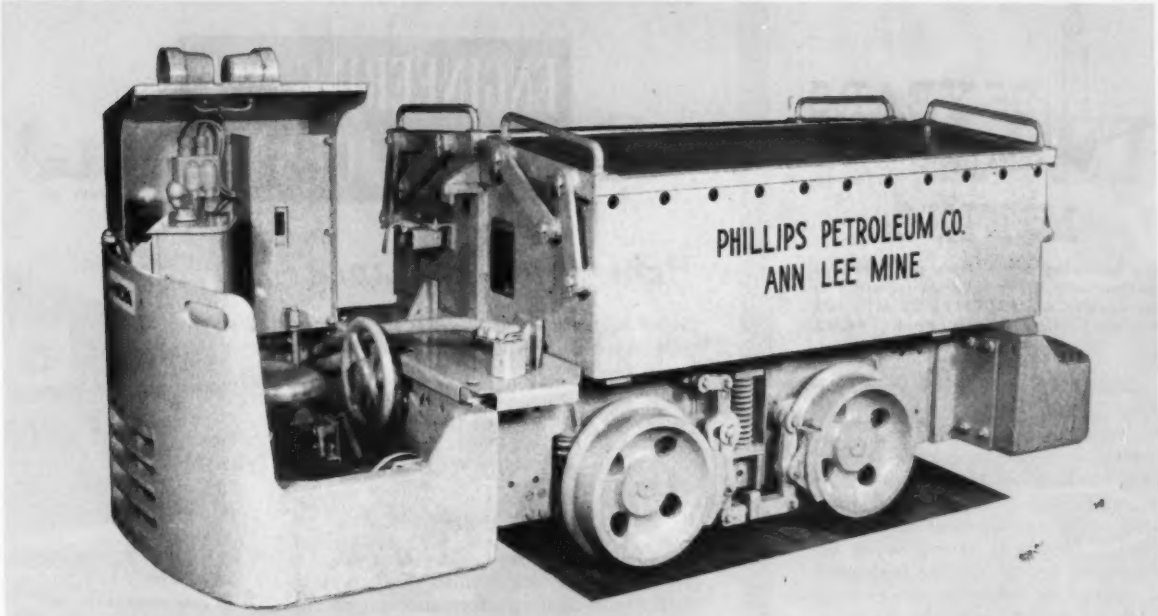
In another fluid-handling story (on p 96), Bunker Hill attacked an important maintenance problem in its process flowsheet by introducing a special alloy stainless steel valve.

126 The American Mining Congress Annual Meeting in Seattle

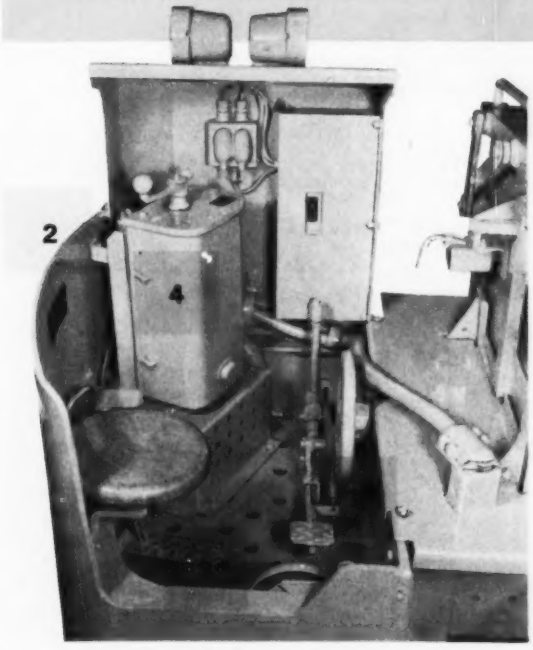
Thanks to some highly-efficient double-teaming by *E&MJ*'s chief editor and its Salt Lake City correspondent, we are able to publish an account of AMC's meeting last month in this month's issue.

18 Flotation's 50th Anniversary — at Denver

E&MJ is preparing a full-length tribute to flotation and to the men who have contributed to its position in the mineral industry. That feature will appear in the December issue, but for a trial run on the subject, and an account of last month's celebration in Denver, see the late news section.



MANCHA'S 4½ ton storage battery locomotive



1. *Safe* . . . Foot operated hydraulic brake—positive, quick action. Requires no adjustment. Only one wearing part.
2. *Safe* . . . Roomy cab with heavy, curved guard plate.
3. *Safe* . . . Deadman foot-switch to prevent operation from outside of cab.
4. *Safe* . . . Camtactor controller for snap make-and-break, prevents dragging contacts, reduces maintenance.

- **Small enough for development work where space is limited and lightweight rail is used.**
- **Large enough for production haulage of heavy trains even on grades against the load.**

Ruggedly built, safe, easy-to-maintain, Mancha's 4½ ton "Titan AN" is the most versatile locomotive you can get. Track gauge (18"-42") can be easily changed at the mine . . . works anywhere independent of trolley wire . . . is unaffected by altitude . . . requires no special ventilation.

Write for complete facts . . .

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DIVISION GOODMAN MANUFACTURING COMPANY
Halsted Street and 48th Place • Chicago 9, Illinois
Cable Address: Mancha, Chicago
Mancha representatives are located in principal mining areas throughout the world.

95 YEARS OF MINING

The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became *E&MJ*.

COLORADO, MAY 1866—Surveyor-General Pierce reports upon the resources of the state: A small iron furnace is in operation near Boulder City, working on kidney ore". Rolling mills will probably be erected during the coming year at Golden City. . . New gold mining is just beginning to arrive . . . the high price of freight rose during the winter to 25 cents per pound, and now stands at 15 cents . . . Many companies are doing nothing; some waiting for machinery; and some fooling away their money by trusting their affairs to ignorant men, and some who never intended to mine outside of Wall Street.

MISSOURI, JANUARY 1887—In the Ironton *Enterprise*, Jan. 12th, a correspondent says: Perhaps no section of country possesses greater mineral wealth than is found embedded within the ranges of hills in S. E. Missouri, and unless scientific theories should prove false, and apparent designs or intentions of Nature are thwarted, Southeast Missouri is destined to become the great mart of the American continent in the production of iron and lead . . . I have no hesitancy in saying this section will become noted for her lead deposits, as she is now noted for her iron . . . But I ask, why are not those minerals more thoroughly developed?

MONTANA, FEBRUARY 1887—The *Post*, Jan. 12th says: It will be remembered that about two years ago a big stampede was made to Wisconsin Gulch, on the Stinkingwater, some thirty miles from here, and how "ye boys" returned disgusted with the whole thing, and pronounced it a "bilk." It appears that a party having some lingering hopes of success returned . . . and took $20 of very nice coarse gold . . . Word leaked out, as usual, and quite a number of cayuses were headed that way, carrying upon their backs sundry individuals who had the "needful" for securing claims.

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

Behind the By-Lines

We've been sleuthing this month. It's not half so mysterious as we might have wished in our younger, more romantic days, but we have had a time.

Over the period of the past year and a half, the major aluminum companies have been talking about a number of long-range-future breakthroughs. Two of the most exciting hints concerned experiments with Idaho clays (and other sources) as potential "ores," and the possibility that direct reduction (the process which may free steelmaking of the blast furnace) might also permit skipping of the alumina stage in aluminum processing.

It's obviously (from our nosing around) too early for anyone to talk about successes in either of these areas. But we're sure you'll find some pretty exciting information on pp 105-109, in our road map for future aluminum excitement.

We took our text for the aluminum story from the greatest sleuth of them all, for what prompted us to chase the story was not what was being said, but what wasn't.

The text comes from our favorite detective, one S. Holmes, of London, in the following exchange with his faithful foil:

"Watson, I call your attention to the barking of the dog."

"But, confound it, Holmes, the dog didn't bark!"

"Precisely, my good friend. Precisely."

Our announced affection for Cousin Jack stories in last August's issue has produced the happiest of windfalls. Mr. R. H. Pearson, formerly of Gardner-Denver and now of Air Rentals, Inc., has most kindly passed along part of his collection.

Mr. Pearson points out that Cousin Jack stories are always about Jan and Bill, just as Pat and Mike were for the Irish.

We don't have room for them all, but here's a couple of favorites, courtesy of Mr. Pearson.

Jan was walking through an old drift and fell into a water-filled sump of an old winze. He hung to some floating timbers until Bill came along and heard him calling. After pulling Jan up, Bill asked, 'How did ye 'appen to fall in ther winze, Jan?' Jan explained, 'I was walking along the drift when I came to the winze. I stepped on the plank to cross the winze and the plank weren't there and down went I, plank and all.'

Jan and Bill were setting a heavy stull to support some bad ground and Jan was using a plumb bob to get it vertical, as the mine captain had told him to do. Bill was using the sledge to knock the stull into the required position. After numerous healthy swings failed to get it quite straight, Bill took one more healthy wallop—came over and tried the plumb bob himself. 'There now, Jan. Now she's more than plumb.'

Jan and Bill were timbering a raise. Jan called down to Bill, 'Cut me a piece of two-foot-fourteen, my son.' Bill replied, 'You mean three-foot-two, don't you?' 'Make it two-foot-fourteen, you bloody fool, I got the rule up here, ain't I?'

One more, and we'll have to go. This one came from the flotation meeting in Denver last month (p 18).

Two ion exchange resins were traveling in New Mexico and came to the Anaconda concentrator at Grants. Said one:

"Say, there's a classy joint. Let's go in and get loaded."

"You go ahead, if you want to," said the other, "but I'm heading for the stripping stage."

HALLIBURTON PEERCE-ALL

GroutJET & GroutBULLET

two new tools for pinpoint control of grout placement!

Halliburton's all-new Groutjet and Groutbullet are *in service now* giving better control of grout placement in most all types of pressure grouting jobs. These advanced tools create entry points for grout placement far more efficiently than old fashioned strap-packer/slotted-pipe methods.

how they work . . .

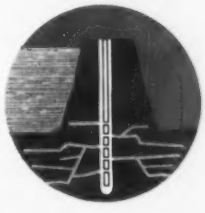
GroutJET is made up of a series of economical shaped charge piercing units which is run on an electrical wire line into cemented grout pipe. At the desired depth, the shaped charges are ignited electrically. The controlled action of each charge pierces the pipe and cement sheath extending a short distance into the formation. Each clean, straight opening provides a predetermined entry point for the grouting solution to follow with little possibility of grout intrusion into an unwanted area. This expendable tool disintegrates in performing its job, leaving only the wire line to be pulled from the pipe.

GroutBULLET is a more economical tool containing one or more sections equipped with electrically-fired "bullets" which, when fired, pierce the grout pipe and the formation. Unlike the Groutjet, the Groutbullet may be used in uncemented pipe as well as minimum-sheath cemented pipe. This tool is run and retrieved on an electrical wire line.

* * *

Halliburton Progress in the field of pressure grouting is marked by many achievements including advanced cement and chemical grouting materials, modern placement equipment and techniques – and now the Peerce-All Groutjet and Peerce-All Groutbullet. See your Halliburton pressure grouting engineer for proven ideas on the best way to solve soil consolidation, water control, and other grouting problems.

Halliburton is fully qualified to perform any size grouting operation as a prime or sub-contractor.

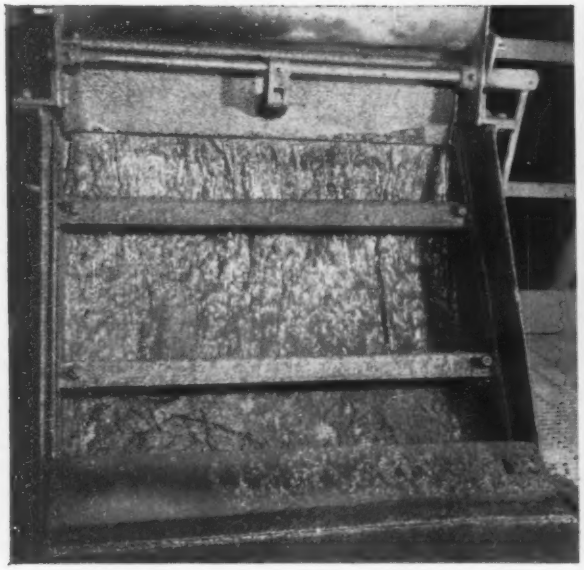


PRESSURE GROUTING SERVICES

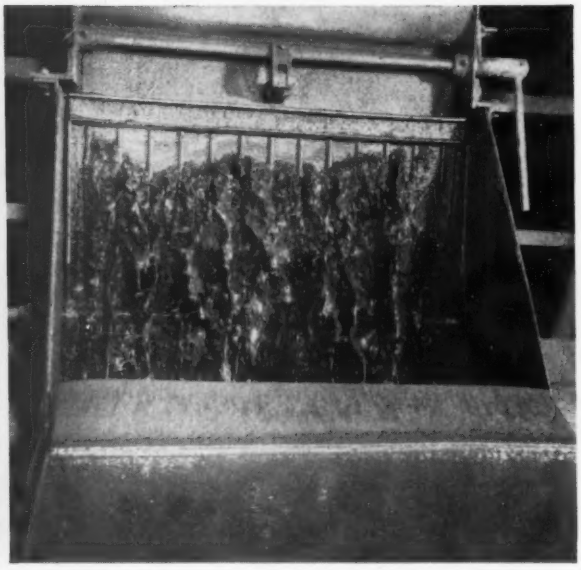
Halliburton
COMPANY • DUNCAN, OKLAHOMA

Unique DORR-OLIVER DSM®

boosts rod mill in closed circuit



Front view of the Dorr-Oliver DSM Screen. Gravity fed oversize is seen here moving down the front surface of the screen. It will be returned to the rod mill for further grinding.



Rear view of the same screen, showing slurry of undersize particles coming through the screen for withdrawal and further processing.

The Dorr-Oliver DSM Screen is a compact, housed, curved wedge bar type stationary screen, with provisions for introducing slurried feed tangentially at the top, and withdrawing undersize and oversize product from the bottom.

Separations in the 8- to 100-mesh range are feasible at capacities in excess of conventional screens. The DSM Screen is essentially non-blinding, with undersize at approximately one-half screen mesh size and smaller. It has no moving parts. Maintenance is low and is confined largely to periodic replacement of the actual screen surface.

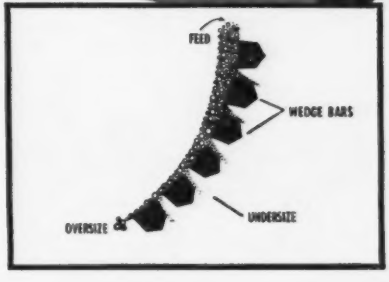
SCREEN

capacity grinding

Using a gravity-magnetic-flotation flowsheet a large eastern U. S. titanium operation processes ilmenite ore to produce a magnetite and an ilmenite concentrate.

Dorr-Oliver DSM Screens are used in closed circuit grinding to screen out the minus 20-mesh ground ore from the rod mill discharges.

Compared with previously used conventional vibrating screens, the DSM Screens make possible considerably lower operating and maintenance costs...there are no moving parts to wear out, and no power is required to operate the screens. Moreover, the small size and compact design of the DSM Screens have permitted replacement of bucket elevators for rod mill discharge with pumps at lower discharge height. Increased screening efficiency coupled with lower pump head has in turn increased grinding capacity.



The outstanding performance of DSM Screens has led to their use in a wide variety of applications, including screening of gypsum, potash, taconite, and other media.

For further information write to Dorr-Oliver Incorporated, Stamford, Connecticut.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

THEY PLANNED ON "POWERSTEEL" TO HOLD DOWN COSTS

removing overburden and strip mining phosphate

American Cyanamid Company's 500-W dragline in operation at Sidney Mine, Hillsboro County, Florida

"POWERSTEEL" drag ropes prove best in American Cyanamid Co. operation

Depend on "POWERSTEEL" for the long haul. American Cyanamid did when it put "POWERSTEEL" twin drag lines on its big 500-W dragline and proved that it pays to use the best. Even other premium wire ropes can't match the lifting-power or wear-abrasion and fatigue-resistance of "POWERSTEEL". Test "POWERSTEEL" yourself and discover that in the long run it actually costs you less. Contact your nearest Yellow Strand distributor or representative and put it to work for you.

Yellow Strand®
"POWERSTEEL"

BRODERICK & BASCOM ROPE CO.
ST. LOUIS • PEORIA • HOUSTON • SEATTLE

GOODYEAR

Q: What do Goodyear Earthmover Rims have that no others have?

A: MORE times FOUR

1. MORE rims on the job: More tons are hauled on—more earth-moving equipment rides on Goodyear rims than on any other kind. Result: You reap the benefits of the widest, soundest experience in rim design, manufacture and use.

2. MORE kinds of rims: Maximum rim performance stems from proper specification. Goodyear makes the *only complete line* of earthmover rims. Result: The choice that permits you to get exactly the right rim for the job.

3. MORE rim engineering help: Goodyear has more engineers designing *and selling* rims than any other company. And they know tires, too. Result: The help you need in choosing the right rim for top performance—longer tire life.

4. MORE rim "firsts": The first *true* earthmover rim, the first 5° rim, the first tubeless rim—in fact, every major earthmover rim advance was made by Goodyear. Result: The very latest in rim design and manufacture at work, for you.

What better reasons for choosing Goodyear as your rim supplier? Only these: The desire and ability to design and build any rim that may be needed for *tomorrow's* earth-moving equipment. No matter what your rim needs or plans, you'll find it pays to call on Goodyear. See your local rim distributor, or write: Goodyear, Metal Products Division, Akron 16, Ohio.

Lots of good things come from

GOODYEAR

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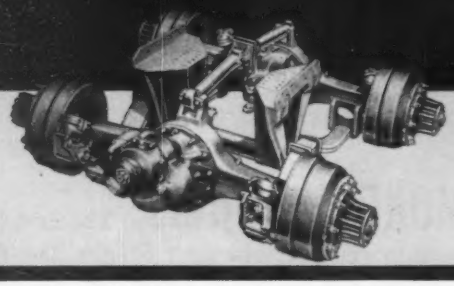
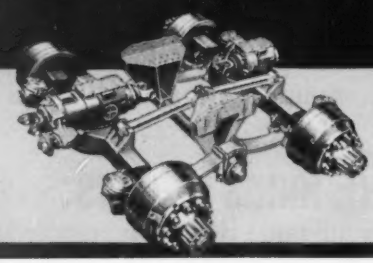
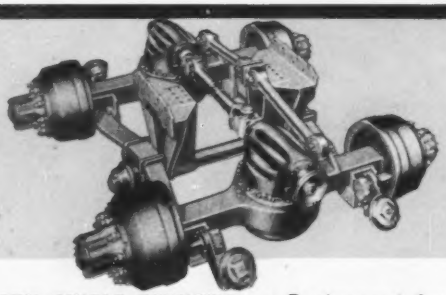


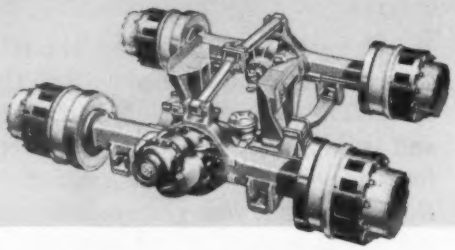
HYPOID SINGLE REDUCTION • Engineered for minimum weight and cost • Husky hypoid gearing for maximum gear strength • Axle ratios up to 8.6 to 1 • Nine models with capacities to 46,000 pounds.



HYPOID-HELICAL DOUBLE REDUCTION • Engineered for universal heavy-duty operations • Balanced hypoid-helical double reduction gearing • Wide selection of ratios • Six models with capacities up to 65,000 pounds.



WORM SINGLE REDUCTION • Engineered for simplicity of design and long life • Worm gear may be reversed to increase operating life • Four models with capacities up to 50,000 pounds.



FULL PLANETARY DOUBLE REDUCTION • Engineered for extra heavy-duty operations • Planetary reduction is at wheel end for greatest mechanical advantage • Capacities up to 150,000 pounds.

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Take a look at it! The solid cast alloy Steel Machinery Bases with cast alloy steel Machinery Side Frames would be massive in a machine of greater capacity. They take the shock of rock digging and eliminate constant rebuilding. The Crowd—different—Dual Independent, an Automatic Crowd *plus* an Independent Crowd—utilizes force most independent crowds waste—handles the tough digging with greater ease—makes easy digging easier and gives greater output. With the big Uniform Pressure Swing Clutches there's no jerk! No grab! Just a smooth swing that makes it easy to spot the load. There's the Feather-Touch Clutch Control that gives the true feel of the load in nudging the teeth under a big one or in probing a partly shot ledge of rock. There's the Cushion Clutch that eliminates the shock overload on operating mechanism, increases cable life, and makes ample power safe. And finally—plenty of power to get the rock out!

It's a rock rig through and through with the advantages that assure output—not just for today—but for tomorrow, month after month.

There is a lot more to tell you. Details make equipment. Dig into them. A Northwest man is at your service.

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Dodge has supplied mounted bearings to industry for over three-quarters of a century. Dodge bearings have always kept pace with improved production practices. Each new condition of service has been met by Dodge as it has arisen, with the result that the Dodge line contains mounted bearings to meet almost every service requirement with pin-point accuracy.

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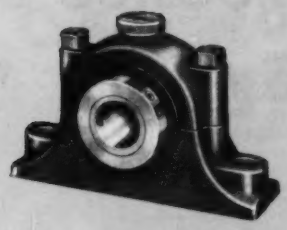
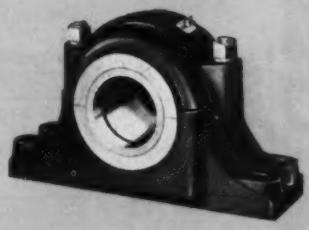
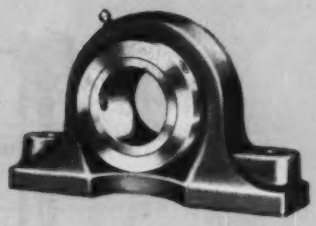


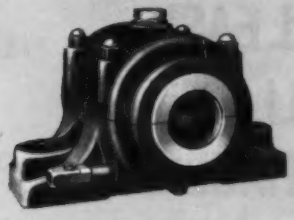
DODGE PILLOW BLOCKS WITH TIMKEN TAPERED ROLLER BEARINGS



DODGE SPHER-ALIGN PILLOW BLOCKS WITH SPHERICAL ROLLER BEARINGS

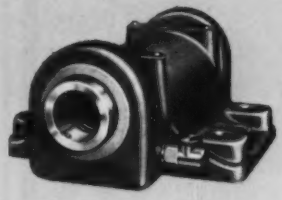


DODGE BALL BEARING PILLOW BLOCKS

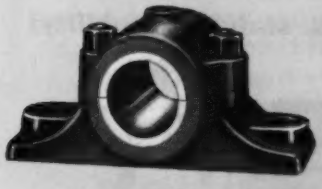


DODGE SLEEVOIL PILLOW BLOCKS

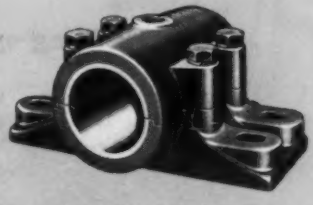
DODGE BRONZOIL PILLOW BLOCKS



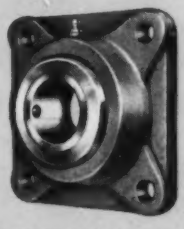
DODGE BRONZE BUSHED PILLOW BLOCKS



DODGE JOURNAL BEARINGS SOLID AND SPLIT



DODGE HEAVY RIGID PILLOW BLOCKS



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● **Dodge Pillow Blocks with Timken Tapered Roller Bearings.** America's quality pillow blocks. Assembled, lubricated, adjusted and sealed at the factory. 5 types for varying needs.

● **Dodge Spher-Align with Spherical Roller Bearings.** Rugged heavy duty, compact, inherently self-aligning. Exclusive Micro-Mount simplifies installation.

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● **Dodge Sleevoil Pillow Blocks.** Ultra quality . . . extra long life . . . accessibility . . . *quiet*. Plain or water-cooled.

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● **Dodge Journal Bearings — Solid and Split.** True running, dependable. Babbitted bearings with precision machined bores and faces. Finished bases.

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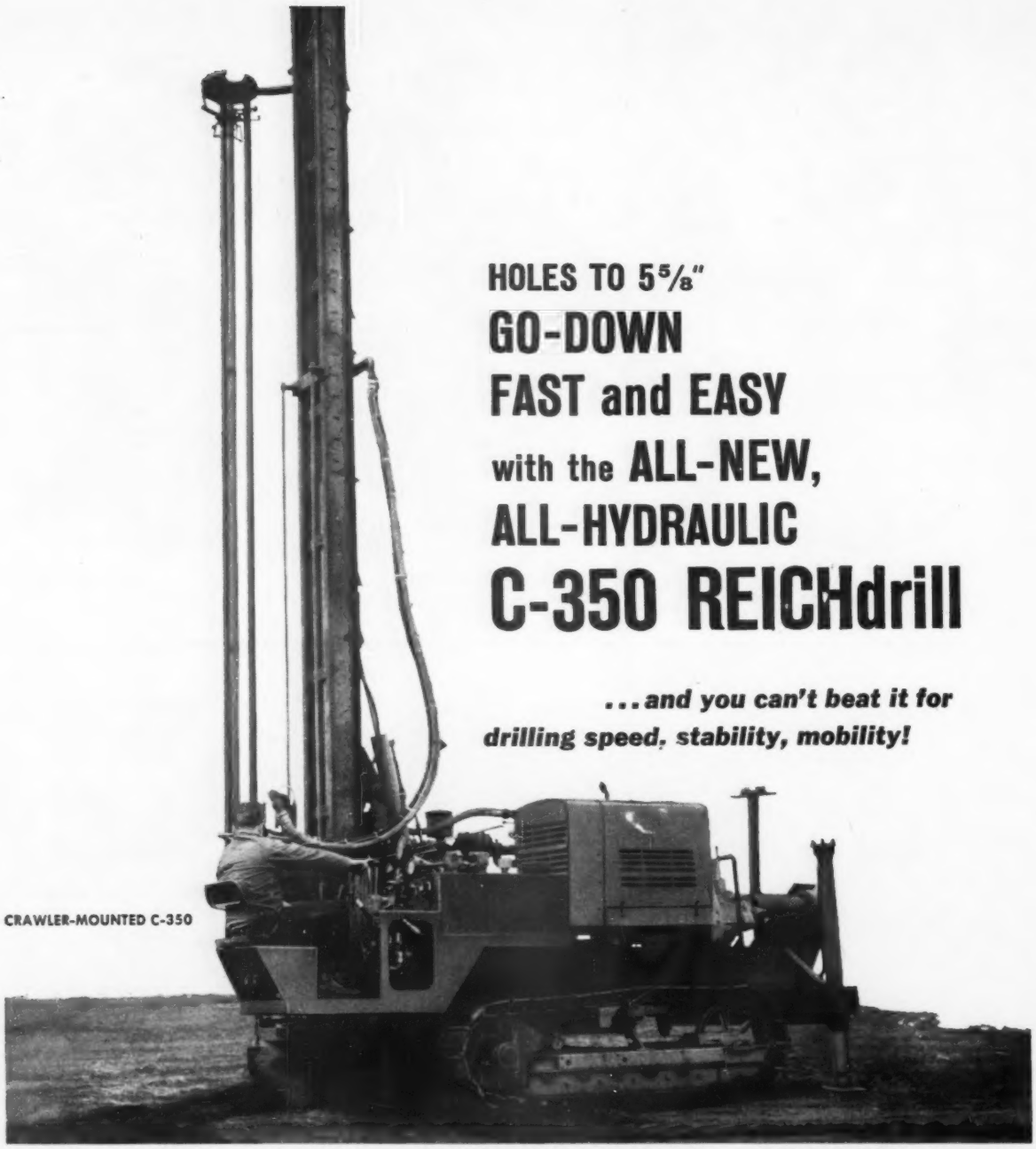

CRAWLER-MOUNTED C-350

HOLES TO 5⅝"
GO-DOWN FAST and EASY
with the ALL-NEW, ALL-HYDRAULIC
C-350 REICHdrill

...and you can't beat it for drilling speed, stability, mobility!

NOMINAL HOLE SIZE—1⅞" to 5⅝" • DOWN PRESSURE—10,000 LBS. • ROTARY SPEED to 540 RPM

Easy Operation is assured by all-hydraulic, labor-saving controls. *Stability* is provided by 14" wide tracks, low center of gravity and 8'8" wide frame plus 3 REICH heavy-duty hydraulic leveling jacks. *Mobility* is high because the crawler-mounted 350 trams at 7.8 MPH; climbs 25% grades, turns in its own length. *Versatility* is basic in REICHdrill design. The 350 is at home blastholing with 3-cone rotary bits, In-Hole Drills, or drag bits; and whether coring or prospecting.

A truck-mounted T-350 REICHdrill for greater mobility with all the above advantages, is also available. Get detailed specifications.

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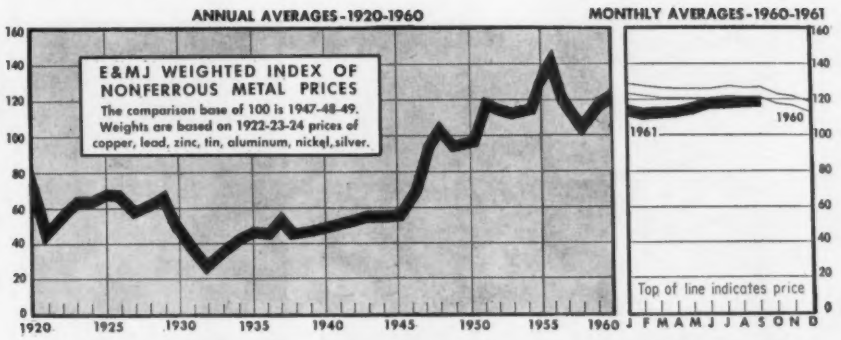
E&MJ OUTLOOK

PRICES


ANNUAL AVERAGES-1920-1960
MONTHLY AVERAGES-1960-1961
E&MJ WEIGHTED INDEX OF NONFERROUS METAL PRICES
The comparison base of 100 is 1947-48-49. Weights are based on 1922-23-24 prices of copper, lead, zinc, tin, aluminum, nickel, silver.
1960
1961
Top of line indicates price
J F M A M J J A S O N D

MARKETS

E&MJ's nonferrous metals price index increased slightly from 120.690 for August to 120.746 for September. Higher prices for copper and tin offset a decline of one-half cent for aluminum.

●

AT HOME

Don't expect the present Administration to give up on its campaign to knock out the 25% gold backing of U.S. currency, or its drive to sterilize wilderness areas. These issues will be pushed in the next Congress.

Westinghouse has built a super-conducting magnet weighing one pound which produces a magnetic flux of 43,000 gauss. An ordinary electromagnet producing that strong a field would weigh about 20 tons. The solenoid of fine wire is made of a columbium-zirconium alloy.

Investment service bulletins have been recommending silver for many months. Says Value Line Survey, "A projected silver price rise of 10-15¢ per oz seems likely to occur within the next 6 to 12 months." By 1964-66, the Survey reports, silver could be selling from $1.15-$1.20 per oz.

●

The fuel cell is progressing faster than expected. A 200-kw cell is being developed for near-term commercial use. The Navy will install fuel-cell power units in diesel-powered submarines. These units are expected to "rival the revolutionary capabilities of nuclear propulsion." Sun Oil Company and Electric Storage Battery Company have signed an agreement to exchange research information for the development of fuel cells.

Start looking for a tellurium mine. Tellurium is one of the favored constituents for thermoelectric devices. A Chicago hotel is installing 500 thermoelectric freezers.

●

LABOR

International Mine Mill and Smelter Workers has been lobbying aggressively for Senate action on the Mine Safety bill.

IMM&SW has documented a strong case objecting to Japanese government-subsidized expansion of copper smelting which has syphoned off throughput of scrap and concentrates at American tidewater smelters.

●

ABROAD

Japan is establishing Overseas Mineral Resources Development Co., a semi-government company which will engage in research, prospecting, mining, import and sales of copper ores and other minerals.

Anglo American Corporation announced that it will go ahead with plans to develop a $126-million iron ore project at Ngwenyo (Bomba Ridge) near Mbabane. A contract for the sale of 12-million tons of iron ore to two large Japanese steel companies is being negotiated. Ore will be hauled over a $22½-million company-built railroad to Lourenco Marques, where it will be loaded into 65,000-ton ships.

Cuba is seeking Soviet help to build additional shops at Moa Bay, and a nickel refinery. TASS says that Soviet equipment and engineering will permit completion of the plant next year.

THIS MONTH IN MINING

WORKING SESSIONS and social sessions were in balance at the 50th anniversary celebration. Left, speakers at the first session included (back) Phil Allen, Norman Weiss, Donald McGlashan, Roshan Bhappu; (front) Luigi Usoni and A. M. Gaudin. Dignitaries at the banquet (reading from 7 o'clock) Mr. and Mrs. R. R. McNaughton of AIME and Trail, Mr. and Mrs. Norm Weiss, Mrs. Frank Briber, Sr. and Mr. Briber. Registrants praised the organization of the sessions.

Flotation Anniversary Noted in Denver

FOR THE SECOND TIME this year an AIME regional meeting devoted to a single technical field drew hearty praise from those who attended the sessions. The first was the International Agglomeration session at Philadelphia in mid-April (see May E&MJ). The second was the Fiftieth Anniversary of Froth Flotation in U.S.A. sponsored by the American Institute of Mining, Metallurgical and Petroleum Engineers, in Denver, Colorado, Sept. 17-20. Some 500 mining men attended, and nearly all attended the packed sessions on schedule.

The meeting drew praise for many reasons.

1. All papers, with one exception, were preprints in textbook style by the Colorado School of Mines, and handed out at the registration desk. Subjects and authors covered in the 600 pages of the preprint volumes are listed in the accompanying program.

2. Except for one afternoon, this was a single-session convention. Attendees didn't have to go hedge-hopping from one meeting room to another to hear papers of special interest.

3. The meeting drew many of the best authorities on flotation theory, reagents, equipment design and flowsheet planners from universities, research laboratories, equipment and reagent manufacturers, from the U.S. and abroad. Many of the retired men who contributed to flotation's advances attended or gave papers. One Denver member said "You don't have to plow your way through a bunch of oil, gas, and mine operators to get to talk to the high-powered talent on flotation at this meeting."

4. Attention to a single subject in depth brought out significant developments in the field of flotation—particularly this, that flotation is becoming so complex that progress will only be made by coordinated corps of specialists rather than by individuals trying to master the whole field. One veteran who has participated in the design and construction of many mills listened to a morning's session in which such comments and phrases were circulated as common coinage—"preferential accumulation of ions and electrons, by adsorption, within the electrical double layer", "the researcher of tomorrow may formulate a thermodynamic approach to further the understanding of the solid-liquid interface", "the degree of ionization at particular pH values has substantial bearing on their effectiveness as resin floaters, the approximate pH values (where 50% ionization occurs) etc.", "we call this process the LIF process (Leach-Ion Exchange Flotation)." The veteran designer threw up his hands. "I thought I knew something about flotation, but after this session, I've got it up to the top of my head, and flotation will soon be going over the top."

5. Despite the necessary ultra-technical coverage of some papers, most of the authors refrained from reading entire papers and kept within time limits. They either read abstracts covering highlights, referred to brief notes or cards, or spoke extemporaneously, often explaining slides or tables.

6. Discussion and comments after the papers had been given reflected the technical competence of the participants and added interesting and stimulating sidelights. For example, A. M. Gaudin complimented a speaker on the excellence of the research work reported and then observed that flotation of materials in media other than water (or brines) offered interesting possibilities. He noted, for example, that in blowing air through molten tin in one refinery certain particles attached themselves to the bubbles of air and rose to the top of the melt much the same as minerals do in conventional flotation process.

The origin of flotation is a subject of perennial and friendly dispute. From a historical standpoint E. J. Pryor's paper "Flotation's Early Years," is a scholarly presentation profuse with names, dates, facts, and a dozen interesting illustrations of early machines. His paper documented patents and developments in England and elsewhere—but particularly England because this certainly is one focal point of origin that gave commercial flotation its momentum. Most notable were the patents of Minerals Separation, Ltd., mentioned widely in international mining literature, as well as in law suits that plagued the early development of flotation.

In a refreshing supplement, Luigi Usoni, director of the National Council of Research, Rome, Italy, listed great names in the development of flotation including Haynes, the Bessel brothers, Everson, Bradford, Potter, Delprat, Froment, Macquisten and Elmore. He reminded the audience that Froment described a true froth flotation paper in 1902, and in 1903 he ceded his patent on flotation to Minerals Separation, Ltd., of London. Minerals Separation subsequently modified and perfected it until within a few years, it was in practical use in the mining industry throughout the world.

Members honored at the banquet table included Frank Briber, Sr., chairman of the symposium committee; J. D. Vin-

cent, chairman of the 50th Anniversary committee; A. M. Gaudin, A. W. Fahrenwald, Nat Arbiter, and Norman Weiss, all former recipients of the Richards Award Medal for distinguished contribution to mineral dressing, R. R. McNaughton, president of AIME; and Jack Fox, secretary of SME.

Flotation Highlights

Frank R. Milliken, president of Kennecott Copper Corp., delivered the session salute to flotation at the banquet in an address "Flotation—The Mainspring of the Minerals Industry." He was honored with this assignment because of his own career in minerals beneficiation. Following greduation from M.I.T., Milliken worked for General Engineering Co., Kennecott Copper Corp., National Lead Co., and again with Kennecott since 1952. He received the Richards Award in 1952 for his work on the beneficiation of ilmenite ores.

Milliken rated flotation as important as smelting, first significant ancient metallurgical art, because of its impact on society and economics. Flotation, which gathered momentum about 50 years ago, is now used to process about 100 metals and nonmetallics.

Using copper as an example, Milliken noted that grade of ore is steadily declining. Average grade of ore mined in the U.S. in 1935 was 1.57%; in 1960 it was 0.72%. Wages have steadily increased; and yet, as the result of flotation and other technological progress, the relative cost of copper has declined. In 1911, he said, wages for one hour bought about 1 lb of copper; today one hour's wages buys 7½ lb of Cu.

In 1960, 198-million tons of ore were processed by flotation in the U.S. to produce 20-million tons of concentrates with $1-billion worth of recoverable products.

"No one person can be designated as the inventor of flotation," Milliken said, "to explode once and for all, attempts to designate a single person the father of flotation. Flotation's development and origin is based on the contributions of many people," he said.

The critical need for a new process to supplement or replace gravity separation was made clear in the classic Richards volume on ore dressing in 1909. Use of the Minerals Separation process in the zinc concentrator of the Butte Superior Copper Co. in Montana in 1911, he said, accounts for our celebration of the 50th Anniversary of that event as the first significant commercial application of froth flotation in the U.S.

During the early years of flotation in the U.S., the art was plagued with numerous suits. But when the patents expired in 1922, "litigation, confusion and lack of public information concerning flotation" ended, Milliken said, and thereafter many independent metallurgists proceeded to develop the art into an advanced technology.

(*This Month continues on p186*)

As We Went to Press . . .

National Lead Co.'s McIntyre development at Tahawus, N.Y., was the site of intensive study of the long-discussed potential of reducing crusher costs by expanding use of explosive in the initial blast in the pit.

The results of the tests, which were given at the American Mining Congress meeting in Seattle last month, are abstracted in this issue, on p 184.

AMC heard some frank talk from industry leaders on recent successes and failures: the former in the field of technology and mining practice, the latter in the field of legislation. That story, based on late-hour reports from editors on the spot, starts on p 126.

Three major appointments were announced by mining companies late last month. C. D. Michaelson, former general manager of Kennecott Copper Corp.'s Western mining division, was named vice president in charge of mining for the corporation.

Richard S. Newlin, vice president in charge of operations at Anaconda Co., was named to the company's board of directors.

In the third announcement, Robert C. Hills, executive vice president of Freeport Sulphur Co. since 1955, was named president of Freeport, succeeding Charles A. Wright, now vice chairman of the board of directors. The announcement was made by Langbourne M. Williams, chairman.

Freeport Sulphur, incidentally, came through last month's Hurricane "Carla" with a major startup staring it in the face. The Grande Isle Mine, the only offshore sulphur producer in the world, had to be shut down when the storm threatened, and all personnel evacuated.

A volunteer crew stayed at the shore terminal of the mines' heated pipeline and maintained circulation of the 320° hot water in the line to prevent solidification of sulphur in the pipe. The men reported winds of 75 mph, but only minor damage was found on return to the artificial island by the full crew.

Anaconda Co. is investigating beryllium claims in the Spors-Topaz Mt. area of Utah held by Combined Metals Reduction Co. and others, including Charles A. Steen of Reno, Nev.; David J. Stone, Palo Alto, Calif. oil man; Lorry Free, Provo; Irving Bennett, New York; and O. F. Burton and C. W. Christensen of Salt Lake. Drill rigs owned by the copper company moved in late in September.

Anaconda is still investigating the Mt. Wheeler beryllium holdings in Nevada.

U. S. Judge Ewing T. Kerr has awarded Gaddis Mining Co. a $230,379 judgment from Continental Materials Corp. and Continental Uranium Corp. of Wyoming.

Gaddis had sued the two firms, which are headed by the Gidwitz family, claiming payments were due under a written agreement arising out of Continental's purchase of uranium claims in Fremont County Wyo., in 1956.

Hanna Mining Co. will increase the capacity of its Groveland iron ore concentrating plant in Michigan from 700,000 to 1.5-million tpy and will install facilities to produce 1.25-million tpy partially fluxed pellets.

WASHINGTON IMPACT

Highlights

SILVER PRICES must soon be resolved by the Administration. Now that Congressmen are home, Treasury has been ordered to finish its study of the silver situation to make a recommendation for action. In the wrestling match for silver, the protagonists are: silver-lead-zinc producers teamed with a bloc of Western Senators versus the silver consumers and a bloc of New England Senators.

The Western Senators made the first move by sending a letter to President Kennedy demanding that Treasury stop its practice of selling silver to the public out of free silver stocks at what was termed "unrealistically" low prices. According to the Silver Act, Treasury must buy silver from all U. S. producers who want to sell at a price around 90¢ an oz. This was done to serve as a floor to support the depressed industry. Now, the situation has changed and the floor has become the ceiling. Demand is outstripping supply and producers are protesting the 91¢ per oz selling practice maintained by Treasury. (See AMC Report, p 126)

Silver consumers, compared with silver producers, have been relatively meek in past silver price hassles. But now, their resistance is stiffening. A bloc of New England Senators has been working on a bill which would call for the repeal of the entire Silver Act, freeing both silver floor and ceiling prices. Apparently, the silver consumers feel that the "momentary" price rise resulting from erasing Treasury as an active silver trader would be more than offset by the long-term gains of prices coming back down. Treasury would probably like to get out of the active trading business. It is against artificially hiking its prices, and doesn't seem to want to stop selling although free silver stocks are draining.

President Kennedy has been admonished by the mining industry for failure to get hoped-for relief. Silver price boosts, the industry feels, would act as a shot in the arm to the depressed lead and zinc mines (some three-fourths of U. S. silver comes as a by-product from lead, zinc, copper mining). But such important mining states as Oklahoma, Missouri and California have been notably absent from silver price hike appeals. California, once a major net-producer of silver is now a major net-consumer.

No matter what decision Treasury makes on silver, the price is bound to rise for the short haul. World demand has edged up over production. But, as in the past, the long term seems to pull prices back down again. This is what consumers are counting on. Producers and Western Senators will fight to keep the "insurance" of the hard-won 90¢ Treasury floor price for the industry if the New Englanders are successful in at least getting Silver Act repeal bills up for hearings.

DURING THE CONGRESSIONAL INTERIM, tariffs will be another item to keep an eye on. It looks like the next Congress will be of more protectionist bent than any other Congress has been for years. The House Ways and Means Committee threw the first punch in the tariff battle by giving unanimous approval to a bill which would sharply raise tariff duties on lead and zinc (3¢ per lb hike for lead duties, 2.5¢ for zinc). As a concession to the Administration, which is against tariff increases for diplomatic reasons, the committee delayed the effective date until April 1962.

But, the Administration will throw its real body blows on tariffs when Congress comes back in January. The Administration is reported to be working on a tariff block-buster which would call for an across-the-board lowering of almost all tariffs. This move, ostensibly, would be for lacing the U. S. in with a virtually free-trading area, including Europe and Canada. But, as a minimum, the Administration might be just using this "free-trading" area talk to shock Congress into at least voting a continuation of the Reciprocal Trade Act which comes up for vote. Strategists liken this move to the Administration's push for five-year "back door" Treasury financing in foreign aid. Congressmen were so upset over this declared infringement of their rights to review, they gave the Administration nearly $8-billion in aid money—the biggest amount, by far, in U. S. history. But Government sources believe the Administration couldn't ask such industries as mining and textiles to be included in a tariff-lopping move. The move would just make it harder for lead and zinc to get any new tariff increases.

Be, Cu, Pb, Go Into Stockpiles; Tin Out

STRATEGIC STOCKPILES are getting a shakeup. Some metals are being tossed in, others tossed out. Among the metals going in are beryllium, oxygen-free high-conductivity copper and lead.

Beryllium will be added as a relief measure for beryllium producers whose production capacity has, in some cases, been expanded much faster than research can create new demand. In order to get the metal stockpiled, producers must arrange swaps of U.S. agricultural surpluses with beryllium ore miners in friendly foreign countries (primarily, Brazil, India and African countries). The ore must be processed in the U.S.

The oxygen-free copper will be worked the same way as the beryllium but the ore can be processed in other friendly nations. As to the amounts of copper and beryllium going into the stockpile on the agricultural barter deal, Government officials said it is "secret." But, one source maintains the amount of beryllium would be "a fair amount, but nothing spectacular." The lead will come from Broken Hill and Cominco (see E&MJ, September, p20).

Tin is an item that is going out of the stockpile. General Services Administration is doing a lively business in tin and is hoping to do a lot more—or as much as it can before the London International Tin Agreement meeting.

GSA has been whittling away on a non-strategic stockpile of tin which totals around 4000 lb—Texas Longhorn supply. But, GSA also asked Congress for permission to sell 50,000 tons of pig tin from the strategic stockpile. Congress was later asked to waive the official six-month waiting period for a stockpiled item up for release. Congress didn't have time to act on the waiver request and technically didn't have to act right away on the over-all 50,000-ton release request. The waiver would have covered only 10,000 tons. Congress will clear the tin in the next session as a routine matter. The six-month waiting period runs from GSA's request date, which was early in September.

Diplomatically, the U.S. wants to have the price of tin come down to a point where more than lip service can be given to possible entry into the International Tin Agreement. The high price of tin was one stumbling block facing possible U.S. entry.

Hope Seen for Better Mine Climate in Brazil

BRAZIL's political picture has now come into focus after more than a month of chaos. When President Janio Quadros quit, throwing the country into a fight

between super-nationalist politicians and the military, the outlook for foreigners in mining was gloomy.

Now politics have settled down and Brazil may even be a little more friendly toward foreigners, especially the U.S. Vice-President Joao Goulart is the titular president of the country with Tancredo Neves, a compromise political peacemaker in as the new premier in Brazil's experiment with a parliamentarian type government.

But, Juscelino Kubitschek, president from 1959 to January of this year, is looming as the real political heavyweight in Brazil. Kubitschek, from the big mining state of Minas Gerais (where M. A. Hanna is trying to negotiate an iron ore deal) was the first Brazilian of stature to come to the U.S. after the political debacle. He talked with President Kennedy for nearly an hour, later plugging Panamericanism and the "Western Community" before the Organization of American States.

Even though the new Brazilian cabinet now includes Gabriel Passos as Minister of Mines and Energy, it is expected to follow top level policy, not Passos' own ideas, on mining and new investments. Kubitschek may be the deciding figure here—he's for foreigners coming in with big investments, but with Brazilian partners.

Inter-American Bank Grows in Aid Stature

INTER-AMERICAN BANK is rapidly gaining stature in the increasingly popular international aid and loan business.

The bank was formed two years ago to form a development kitty for all Latin American countries with the U.S. putting up the highest ante. Big loan organizations didn't give much thought or importance to the new upstart then.

But, now it looks like Inter-American Bank might be the future central organization to coordinate the Alliance for Progress billions going to Latin America.

Mining ventures are on the Bank's list for loan requests. Because the Bank directorate is made up of Latin American as well as U.S. leaders, mining loans might be aimed at "national" mines or those mines with mixed foreign and local capital.

An example of mining loan need is Chile. Chile over the next 10 years must spend $10-billion for development —$720-million is pegged for mining directly, another $300-million indirectly (roads, railroads, processing industries).

Chile expects to finance $8-billion of its program on its own with $2-billion hoped to come from foreign sources. Mining heads the list of "foreign sources" on Chile's foreign loan or investment shopping list.

Labor This Month

MINE-MILL GIRDS FOR 1962: Facing major nonferrous bargaining contests with employers and renewed jurisdictional fights with rival AFL-CIO unions, Mine-Mill and Smelter Worker officials have lined up formidable support for the year ahead. Their "mutual aid" pact, signed with International Brotherhood of Teamsters president James R. Hoffa places a powerful ally in the Mine-Mill camp. It not only guarantees picket line support from strategic truckers, but also pledges joint organizing drives and a respect of each other's jurisdiction, plus joint legislative drives.

Actually, the agreement is a return to a similiar pact between Mine-Mill and the Teamsters which petered out more than three years ago. While it gives MMSW an important shot-in-the-arm, the new alliance may mean additional troubles for the nonferrous union. By aligning with Hoffa, Mine-Mill may find itself a target of the Hoffa opposition, which shows no signs of disbanding despite the IBT leader's growing power. AFL-CIO resistance to the Teamsters is picking up and if the federation's unions go after the Teamsters in earnest, they will include Mine-Mill in their efforts. Thus, it could provoke more jurisdictional troubles with the big steel and auto unions and possibly precipitate an all-out struggle.

An unlikely event, at this juncture at least, is absorption of Mine-Mill by the giant Teamsters. Both sides disclaim this happening. "This is a pact for mutual cooperation and assistance between the two unions and not a merger," says a Mine-Mill spokesman.

LABOR'S NEW BARGAINING GOAL: United Auto Worker Chief Walter Reuther's new contracts with the auto industry set up a brand-new goal for other union negotiators—with the first serious efforts likely to come in steel and nonferrous contract talks in mid-1962. While Reuther's wage gains were nominal, he won a "breakthrough" in labor's drive for job security, the keynote of current industrial bargaining. This is the contract clause that provides 40-hour a week paychecks for workers who actually are on the job less than a full week. The auto industry agreed to make-up pay for employes whose work schedule calls for less than 40 hours at the rate of 65¢ of take-home pay for those hours not worked up to the 40 hour limit. Where the short workweek is unscheduled, employes receive one-half their take-home pay.

This is a significant thrust in labor's efforts to keep industrial workers from pay-interrupted layoffs during business down-turns or the shifts in production schedules. It is the first leg up the industrial union ladder towards the final goal of providing the same job security for its blue collar workers that office workers now have. Like most contract innovations—such as pensions, supplementary unemployment benefits, health and welfare fringes and the like—the short workweek benefits of the Auto Workers provide the foundation which other unions will seek to build on.

CONGRESS LEAVES LABOR WANTING: Union legislative strategists, assessing their stocks with the close of Congress, find the cupboard almost bare. Compared with their initial hopes in the Kennedy Administration's first year, the results are disappointing, to put it mildly. After an early Congressional victory in hiking the Federal minimum wage, union fortunes on Capitol Hill went steadily downward. The legislators rejected a plan to revamp the National Labor Relations Board that would speed up handling of unfair labor practice cases; it turned down the powerful AFL-CIO building trades plan that would ease construction site picketing restrictions in Taft-Hartley. Both the ambitious retraining bill for unemployed workers and the proposals for tighter curbs on employer pension plans failed to survive Congressional opposition.

This throws labor's long-range legislative program out the window. With the incoming Kennedy forces, union leaders held back on their major proposals—such as an overhaul of the Taft-Hartley Act—for the first session. They wanted to wrap up the other legislative goals first. But, their energies must now be directed to the next Congressional session, facing the same legislators, and offering the same proposals that failed this year.

MARKETS

Copper Strikes Over; London Depresses U.S.; Aluminum Price Cut; Lead-Zinc Subsidy Passed

THE E&MJ INDEX OF NONFERROUS METAL prices for September was unchanged from the previous month at 120.7% of the 1947-49 average. However, there were price adjustments. A tiny increase in the domestic copper average—from 30.600c to 30.604c—and a 2.1c rise in the N.Y. tin average offset a ½c decrease in the aluminum figure. Prices of other index metals were unchanged. The Metals Use Index September estimate was 107% of the 1950 average, unchanged.

Labor difficulties which plagued the copper market in recent months ended abruptly in mid-September. Kennecott Copper settled with 188 electrical workers whose complaints had led to a complete shutdown at the company's Utah Division.

In Chile, no agreement was reached, but a 60-day truce period sent all workers back to the job. A settlement at El Salvador and Potrerillos is expected before the mid-November deadline. All other workers at Anaconda and the entire Kennecott force were out in sympathy. About 40 to 50,000 tons of copper production was lost at a cost of millions of dollars.

London failed to reflect the loss of output as it did the sharp comeback staged by the U.S. market. European demand waned, partially owing to a shortage of wirebars. Stocks had been pretty well boosted in recent political crises. The situation points up the international aspect of the market. A strong U.S. market is currently being depressed by weakness in Europe. It works this way: once London slips more than 3c a lb below the U.S., it is practical to import metal purchased in Europe, pay the 1.7c tariff, the freight and insurance and sell at higher prices here. These sales, generally somewhat under the current market, help depress any domestic strength that might exist. Such is the case today with the U.S. price for both producers and smelters at 31c and the LME price £221½ (27.7c).

At this writing the Katanga battle for freedom seems headed for peaceful settlement. As far as the Free World is concerned, it is doubtful that copper output in the hands of the Congo central government — if such a thing exists — would be in any better hands than those of Tshombe. But control of its industry may be one of Katanga's peace stipulations.

The U.S. copper scrap market has quieted somewhat. Japanese and European raids on the U.S. market have had their effect on smelters. Rather than bid the price up and take a loss on refined copper sales, smelters apparently prefer to operate at less than capacity.

Hanky-panky in the primary aluminum business since the 1958 recession resulted in some out-and-out warfare between Canadian and U.S. producers in September.

In recent years, while maintaining an ostentatious 26c price, sellers have gone about offering discounts in all forms—for scrap return, for molten metal, for competitive purposes. In response to requests by independent U.S. fabricators who wished to buy in Canada to take advantage of the U.S. dollar premium, Aluminium Ltd., Canada's leading producer, announced a Canadian border price of 22.55c (U.S.). Adding a 1¼c tariff and approximate shipping costs of 1c, U.S. consumers could get delivered metal at about 24.8c or at most perhaps 25.3c. The announcement of the price rather than the price itself pointed up the ridiculousness of the 26c price in the U.S. Alcoa lost no time in slashing its U.S. price 2c to 24c.

It was a tough break for the U.S. industry, since it seemed well on the way to recovery. In fact a price rise for later in the year remained a possibility right up to the time of the Aluminum action. However, the industry was in reality building from a price level well under the paper price of 26c. Some feel the industry will be able to move ahead from the 24c plateau, if it can avoid getting caught in a discounting web.

The U.S. independent probably gained some. His working margin will be increased, if product prices don't slide proportionately, and his abilty to compete with low-price imports improved. Even should his price fall, he will have a better competitive position.

The small lead-zinc mine subsidy bill that Congress passed before adjournment was termed "a step in the wrong direction" by one market observer, the idea being that any encouragement to production is a hindrance to the abysmally low prices for the two metals. Anyway, mines that have not produced more than 3,000 tons of lead and zinc in any year since 1956 will receive $16½-million in aid. Payment will be 75% of the difference between the market and 14½c for lead 55% and 14½c for zinc. The subsidy will be limited to four years with decreasing amounts ranging from 1,500 tpy to 600 tpy the final year.

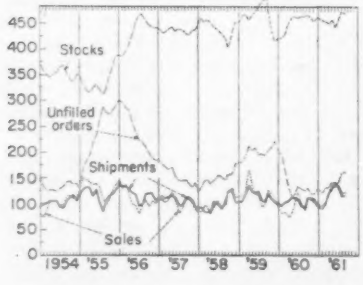
The U.S. zinc market has improved steadily with statistics and sales impressive. Lead deliveries have improved.

September opened with the announcement that GSA was asking Congress for permission to sell 50,000 tons of tin from the strategic stockpile—10,000 tons of which would be sold immediately. World prices—inflated by speculators anticipating a 20,000-ton shortfall of production under consumption—fell sharply.

As the month wore on, it became clear that Congress, under pressure of more urgent legislation, would not act on the request. Markets, consequently, recovered somewhat to close with a 3½c net loss over the month.

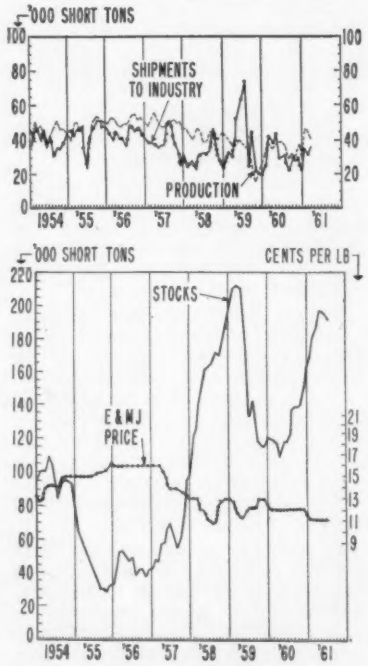
ITC meets on October 9, and the U.S. is sending observers. Many feel GSA's attempt to release stockpile tin was aimed at bringing prices down to a level which would permit the U.S. to enter ITC. This having failed, there seems to be little chance of U.S. entry at present.

U.S. Copper Fabricator Data



Data in thousands of short tons from U.S. Copper Assn. The sales and shipment series are related only to purchases of refined copper by the fabricators, including copper refined by custom smelters from their intake of scrap and concentrates. All statistics refer to brass mills, wire mills and foundries. All series are for fabricated products except stocks which are of refined copper and copper in process. August is the last month indicated. Sales and shipments series are two months moving averages.

Primary Refined Lead Data



The above data, in thousands of short tons, are from the American Bureau of Metal Statistics. They refer to the total amounts of refined lead as reported by all primary refiners in the U.S. Some secondary lead is included. "Shipments to industry" includes exports. Data are through August.

Average Prices September (E&MJ Quotations)

Cents per lb unless otherwise indicated:	
Copper:	
Electro, domestic refinery	30.604
Electrolytic, exports refinery	28.036
Electrolytic, c.i.f. Cont'l ports	28.981
Lead:	
Common, New York	11.000
Common, St. Louis	10.800
Silver:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz.	79.750d
Zinc:	
Prime, Western, East St. Louis	11.500
Prime, Western, delivered (g)	12.000
Tin:	
New York Straits	121.881
Gold, per oz., U.S. price	$35.000
Sterling Exchange	281.222
Quicksilver, per flask	$188.000
Antimony, (E&MJ) (d)	36.250
Antimony, bulk Laredo	32.500
Antimony, in cases, Laredo	33.000
Antimony for, 99% (h)	28.250
Palladium, troy oz.	$24.000
Platinum, refined, per oz.	$82.000
Cadmium (a)	160.000
Cadmium (b)	170.000
Al 99½% unalloyed ingot	25.500
export ingot	23.250
Magnesium, ingot	35.250
Nickel (f)	81.250
Bismuth	$2.250
Cobalt	$1.500

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quicksilver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

Free Gold Market

Gold sales declined 7% during September in international markets. The yellow metal prices reached a seven month peak of over $35.21 in London but were generally weaker in most areas except in the Far and Middle East. Gold futures trading rose 10% over the previous and substantial August increase and premiums remained unchanged. Six month deliveries listed 6½% per annum against ours, 5½% per annum versus Deutsch marks and 5% per annum against Swiss francs. Combined transactions in London and Zurich were estimated at $2.2 million dollars per working day. The U.S. gold stock remained unchanged at $17.452 billion dollars. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	Coins		Bars	
	Aug. 31	Sept. 30	Aug. 31	Sept. 30
New York transit	.....	.....	$35.30	$35.29
Manila	$42.10	$42.15	36.20	36.25
Hong Kong	48.25	48.25	39.25	39.10
Bombay	56.75	57.20	53.00	54.50
Beirut	42.45	42.05	37.35	35.37
Paris	42.20	42.15	35.77	35.75
Buenos Aires	41.50	41.80	36.50	35.70

Note: Prices are quoted at the free or black market value of the U.S. dollar in the local markets.

Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of September reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛¢; ¼¢ deducted for selling common.

Delivered consumer's plant	30.750 lb
F.o.b. refinery	30.350 lb

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

Sept. 1961	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (e)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Unalloyed Ingot 99%	Straits Tin New York
1	30.600	28.075	29.020	11.000	10.800	12.000	11.500	26.000	125.500
4	Holiday	28.150	29.095	Holiday					
5	30.600	28.625	29.570	11.000	10.800	12.000	11.500	26.000	125.000
6	30.600	28.550	29.495	11.000	10.800	12.000	11.500	26.000	121.500
7	30.625	28.450	29.395	11.000	10.800	12.000	11.500	26.000	122.500
8	30.600	28.650	29.595	11.000	10.800	12.000	11.500	26.000	122.125
11	30.625	28.325	29.270	11.000	10.800	12.000	11.500	26.000	120.500
12	30.625	28.275	29.220	11.000	10.800	12.000	11.500	26.000	120.750
13	30.600	28.300	29.245	11.000	10.800	12.000	11.500	26.000	121.500
14	30.600	28.475	29.420	11.000	10.800	12.000	11.500	26.000	121.000
15	30.600	28.525	29.470	11.000	10.800	12.000	11.500	26.000	120.625
18	30.600	28.325	29.270	11.000	10.800	12.000	11.500	26.000	121.375
19	30.600	28.075	29.020	11.000	10.800	12.000	11.500	26.000	120.750
20	30.600	27.725	28.670	11.000	10.800	12.000	11.500	26.000	120.500
21	30.600	27.650	28.595	11.000	10.800	12.000	11.500	26.000	120.750
22	30.600	27.775	28.720	11.000	10.800	12.000	11.500	26.000	121.500
25	30.600	27.600	28.545	11.000	10.800	12.000	11.500	24.000	122.500
26	30.600	27.225	28.170	11.000	10.800	12.000	11.500	24.000	122.500
27	30.600	27.175	28.120	11.000	10.800	12.000	11.500	24.000	122.250
28	30.600	27.325	28.270	11.000	10.800	12.000	11.500	24.000	122.500
29	30.600	27.475	28.420	11.000	10.800	12.000	11.500	24.000	122.000
AVERAGES FOR MONTH									
Sept.	30.604	28.036	28.981	11.000	10.800	12.000	11.500	25.500	121.881
AVERAGES FOR WEEK									
Sept.									
6	30.600	28.320	29.265	11.000	10.800	12.000	11.500	26.000	124.188
13	30.615	28.400	29.345	11.000	10.800	12.000	11.500	26.000	121.475
20	30.600	28.225	29.170	11.000	10.800	12.000	11.500	26.000	120.850
27	30.600	27.485	28.430	11.000	10.800	12.000	11.500	24.800	121.900
CALENDAR WEEK AVERAGES									
Sept.									
1	30.600	28.230	29.175	11.000	10.800	12.000	11.500	26.000	124.850
8	30.606	28.485	29.430	11.000	10.800	12.000	11.500	26.000	122.781
15	30.610	28.380	29.325	11.000	10.800	12.000	11.500	26.000	120.875
22	30.600	27.910	28.855	11.000	10.800	12.000	11.500	26.000	120.975
29	30.600	27.360	28.305	11.000	10.800	12.000	11.500	24.000	122.350

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Sept. 1961	Silver (c) New York	Silver London	Sterling Exchange	Gold (a) London
1	91.375	79.750d.	280.5540	250s. 10d.
4	Holiday	79.750d.	Holiday	250s. 8½d.
5	91.375	79.750d.	280.9600	250s. 6¼d.
6	91.375	79.750d.	281.1880	250s. 5½d.
7	91.375	79.750d.	281.1500	250s. 5½d.
8	91.375	79.750d.	281.0275	250s. 5d.
11	91.375	79.750d.	281.1640	250s. 3½d.
12	91.375	79.750d.	281.2020	250s. 3d.
13	91.375	79.750d.	281.2020	250s. 4¼d.
14	91.375	79.750d.	281.2150	250s. 5½d.
15	91.375	79.750d.	281.2225	250s. 4d.
18	91.375	79.750d.	281.3533	250s. 2d.
19	91.375	79.750d.	281.3600	250s. 1¾d.
20	91.375	79.750d.	281.3200	250s. 1¾d.
21	91.375	79.750d.	281.3500	250s. 2¼d.
22	91.375	79.750d.	281.3080	250s. 1¾d.
25	91.375	79.750d.	281.3180	250s. 1d.
26	91.375	79.750d.	281.3100	250s. 2¼d.
27	91.375	79.750d.	281.3520	250s. 2d.
28	91.375	79.750d.	281.4520	250s. 2¼d.
29	91.375	79.750d.	281.4275	250s. 1¾d.
AVERAGES FOR MONTH				
Sept.	91.375	79.750d.	281.222	—
AVERAGES FOR WEEK				
Sept.				
6	91.375	—	280.851	—
13	91.375	—	281.149	—
20	91.375	—	281.294	—
27	91.375	—	281.328	—

Calendar Week Averages: New York Silver: Sept. 1, 91.375; Sept. 8, 91.375; Sept. 15, 91.375; Sept. 22, 91.375; Sept. 29, 91.375.

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U.S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

(e) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance. Atlantic ports to main Continental ports. Currently at 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; Cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Premiums for corroding grade have been discontinued.

MARKETS *Continued*

London Metal Exchange Quotations

Sept. 1961	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
1	232¾	233	236	236¼	64⅛	64⅜	66¼	66⅜	75½	75⅝	76⅝	76¾	992	993	993	994
4	234¼	234½	237¼	237½	64⅛	64⅜	66⅛	66⅜	75¼	75⅝	76½	76⅝	989	991	992	993
5	234½	234¾	237⅝	238	64⅛	64⅜	65⅝	65¾	75½	75⅝	76½	76⅝	981	982	987	988
6	233	233½	236½	236¾	64⅛	64¼	65⅛	65⅜	74⅝	74½	75⅜	75½	940	941	952	953
7	232¼	232½	235⅝	236	64⅛	64¼	65⅛	66	74⅝	74½	75⅛	75¼	953	954	963	964
8	232½	232⅝	235⅝	236	64⅛	64¼	65⅛	65⅞	73⅜	73½	74⅝	74⅝	951	952	960	961
11	231¾	231⅞	234¼	234½	63¾	64	65⅛	65⅝	72¼	72⅝	73¼	73⅜	935	936	945	946
12	231½	231⅝	234½	234⅝	64	64⅛	65⅛	65⅞	72	72½	72⅞	73	943	944	950	951
13	232½	232¾	235½	236	64	64⅛	65⅛	65⅞	72¼	72⅝	73	73¼	952	953	959	960
14	231⅝	232	235	235¼	64⅛	64⅛	66	66⅛	72⅝	72⅞	73⅛	73⅝	945	946	955	956
15	231⅝	232	234⅝	235	64	64⅛	65⅝	65⅞	73	73¼	73⅞	74	942	943	954	955
18	230	230¼	233¾	234	64	64⅛	65⅛	65⅞	73⅛	73½	74	74¼	943	944	954	955
19	228½	228⅝	232	232¼	63⅞	64	65⅛	65⅝	73½	73½	74⅛	74½	939	940	952	953
20	226	226¼	230¼	230½	63⅝	63¾	65⅛	65½	73½	73⅝	73¾	73¾	933	935	946	947
21	227¾	228	231⅛	232	64	64⅛	65⅛	65⅞	74¼	74½	74⅝	74⅝	938½	939	951	952
22	226	226¼	230½	230⅝	64	64⅛	65⅛	66	75½	75⅝	75⅝	75½	941	942	956	957
25	225⅝	226	230¼	230½	64	64⅛	65⅛	65⅞	75½	75⅝	75⅝	75⅝	957	958	968	969
26	222½	222¾	227	227¼	63½	63⅝	65⅛	65⅝	74⅝	74½	74⅝	74½	959	960	967	968
27	222¾	223	227	227¼	63⅝	63¾	65¼	65⅜	73¾	74	73¾	73⅞	951	952	961	962
28	225¼	225½	229	229¼	63	63¼	64⅞	65	73⅝	73¾	73⅞	74	960	961	968	969
29	223	223½	227	227½	62¾	62⅞	64½	64⅝	73¼	73½	73¾	73⅞	957	958	965	966
Av'g's	£229.452		£233.065		£63.991		£65.690		£73.943		£74.536		£952.988		£962.310	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper wire basis bars, lead 99.0%, zinc 98% and tin min. 99.7%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

MISCELLANEOUS METALS

September 30, 1961

Aluminum ingot, 99.9% lb		26c
Antimony, spot, lb, less than carload, in cases		36.250c
In bulk, carload lots, f.o.b. Laredo		32.5c
Imported, 10 ton min. (p), 99% Duty not paid	28c —	28.50c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.60
small lots		$1.70
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 99.8% grade, lb, contract delivered	$1.15 —	$1.19
Cobalt, 97 to 99%, per lb effective 3-1-60		$1.50
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)	29.95c
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		81¼c
Other sales, regular sellers		81¼c
Sales by dealers, etc.		81¼c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16		35.25c
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$80 —	$85
Quicksilver, flask of 76 lb, 25 flasks or more	$188 —	$191
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$6.50 —	$7.50
Silicon, minimum 98%, carloads, lb		19c
Hyper-pure; rod per kilo	$385 —	$407
Tellurium, lb		$5.25
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective July 1, 1961; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu; spot	$32 —	$33
term contracts	$34 —	$34.50
Chrome ore per long ton, f.o.b. cars Atlantic ports, dry:		
44% Cr_2O_3 no ratio	(a)$19.75 —	$20.50
48% Cr_2O_3 3 to 1 ratio	$35¾ —	$38
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.85(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$125.16

Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.

Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.40
Columbian-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 65%, c.i.f. U. S. ports, duty extra	$16.00 —	$16.50
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton.		$68

(a) Nominal. (b) c.i.f. U. S. ports.
(e) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4c
Cobalt, oxide, 72¼% to 73¼%, per lb, effective Mar. 1, 1960	$1.15 —	$1.18
Copper sulphate, 100 lb, effective 5-17-61		$12.50
Germanium dioxide, gm		16¾c
Molybdic trioxide, technical, per lb of Mo	$1.59 —	$1.60
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo., lb of Mo contained	$1.63 —	$1.95
Ferrosilicon, 50% per lb of Si f.o.b. shipping point		14.60c
Ferrotungsten, 72 to 82%, lb of W contained		$2.25
Ferrovanadium, per lb of V delivered	$3.20 —	$3.40
Silicomanganese, max., 1½%C, lb contracts		11.6c
Spiegeleisen, per lt, 19-21% grade	$98 —	$101

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper stock	$120–$142
Crude No. 2	$750–$1,155	Waste	$75– $86
Spinning Fibers	$370– $600	Shorts	$40– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$470–$787
Asbestos, Vermont, f.o.b. Morrisville:		Shingle fibers	$142–$325
Spinning fibers	$353– $408	Waste, stucco or plaster	$86
Shingle stock	$181– $218		
Paper stock	$120– $142	Refuse or shorts	$41– $75

Barytes, f.o.b. cars:		
Georgia, crude, per ton		$18
Missouri, 94%, $BaSo_4$, per st	$16 —	$18
Crude oil well grade, min. 4.3 sp gr, st (a)		$18
Imported, c.l.f. Gulf Ports, st	$12½ —	$14
Bauxite, st, f.o.b. point of shipment:		
Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% Al_2O_3, 6% SiO_2, 1.25% Fe, 1-1-60		$7.25
Feldspar, bulk ton, f.o.b. plants:		
Potash or soda feldspar, 200 mesh, ceramic grade	$17 —	$20.50
Glass feldspar, white, 20 mesh		$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —	$41
60% effective CaF_2	$33 —	$36
Acid 97% concentrate, bulk, ton f.o.b. Ill.	$45 —	$50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington		$46

Mica—Domestic, f.o.b. mines. Punch 7c-12c per lb according to size and quality. Sheet clear 1½x2 in, 70c-$1.10; 2x2 in, $1.10 to $1.60; 2x3 in; $1.60-$2.10; 3x3 in, $1.80-$2.30; 3x4 in, $2.00-$2.60; 3x5 in, $2.60-$3.00; 4x6 in, $2.75-$4.00; 6x8 in, $4.00-$8.00. Wet ground, very fine, $140-$155 per ton. Bulk sales, dry ground; $30-55 per ton. Scrap $20-$30.

Ocher, Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, Mexican, for use in Mexico, metric ton, f.o.b. mines, depending on location	$21 —	$23
For export f.o.b. vessel, depending on grade	$22.50 —	$23.50

Actual prices received by U. S. producers approximate the Mexican export prices.

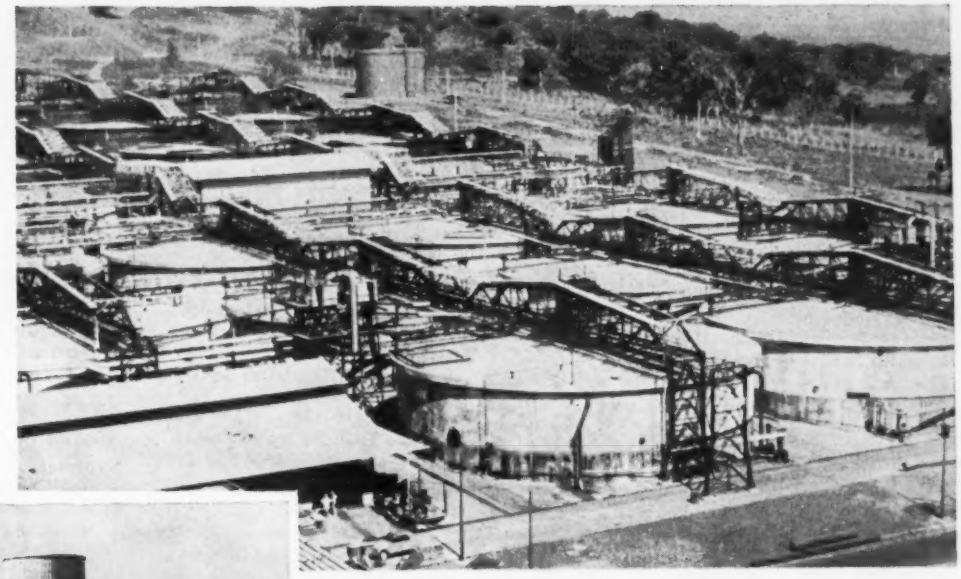
Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

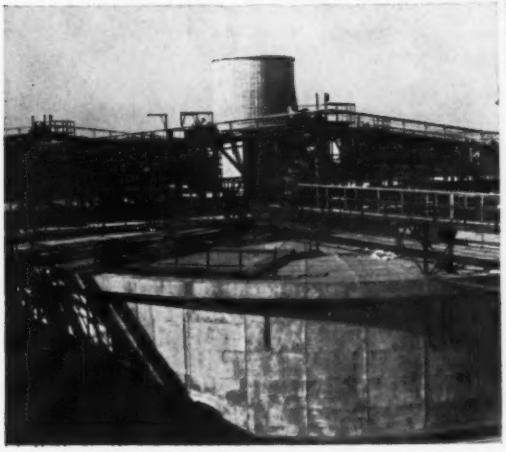
(a) Some restricted sales at $11.50; (b) Corrected; (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

28 EIMCO-PROCESS Thickeners at FRIA





Eimco-Process lifting devices on the 100-ft. diameter thickeners at FRIA permit raising or lowering the entire mechanism 3-ft with no relative movement between shaft and main gear. Operator always has positive control of mechanism position. Mechanisms are double extra heavy duty type. Write Eimco's Process Engineers Division, 420 Peninsular Ave., San Mateo, California, U.S.A. for Bulletin SM-1004.

THICKEN AND WASH DIFFICULT RED MUD

FRIA, an organization owned by Pechiney, France; Olin, U.S.A., and several other European aluminum companies, operates one of the world's largest alumina plants in West Africa.

The huge plant employs 26 Eimco-Process 100-ft. diameter covered thickeners in the red mud washing circuit and two 60-ft diameter tray thickeners for lime mud thickening.

In developing the many special design features for these thickeners, FRIA and Eimco-Process engineers worked as a team, were guided by previous experience in engineering equipment for difficult scaling conditions and extremely high torque requirements. Two identical 100-ft. diameter Eimco-Process thickeners were supplied for the Pechiney alumina plant at Gardanne, France, before FRIA went into operation.

In this same way, Eimco-Process specialists are organized to work with your engineers, to help you get effective solutions to your problems. For details, get in touch with the Eimco-Process representative in your area.

EIMCO

"Advanced Engineering and Quality Craftsmanship Since 1884"

B-845

No. 2 in a series of announcements on new HOUGH *machines*

This all-new 1¾ cu. yd. PAYLOADER

is far ahead

of any machine in its price class . . . in capacity, power, design and performance

The Frank G. Hough Co. has been engaged in a continuous program of research, development and improvement of exising models ever since it pioneered the first four-wheel-drive tractor-shovel. This program led to the new concept and design of the H-30 and H-120 PAYLOADER units which gained tremendous acceptance during the past two years and has helped to maintain PAYLOADER leadership.

The H-60 represents even further progress and development. It is a completely new machine in size and capacity with these special points of interest . . .

High Lift and Long Reach: Note the ease with which the operator deposits a full load in the hopper. Faster, more productive cycles are the result.

Safety and Convenience: All bucket and boom mechanisms are located ahead of the operator compartment for maximum protection. The steeply-sloped cowl and open design give 100% visibility. The comfortable, adjustable bucket seat and conveniently located controls make operation easy. The walk-in operator's compartment is easily accessible with safety ladder and hand rails.

Less Maintenance: Only PAYLOADER units like the new H-60 have a simplified boom mechanism with a single bucket tilt cylinder. This means you have from 4 to 10 fewer pivot and grease points and fewer parts to service and maintain. Furthermore, all pivot points on steering, boom and bucket mechanisms are fitted with "O" rings and other seals which keep grease in and dirt out to provide longer life and less maintenance. The hydraulic steering system uses two direct-acting rams with fewer pivot points.

"Keep-clean" Hydraulic System: A valuable, exclusive HOUGH feature is the closed and pressure-controlled hydraulic system to keep out air-borne dust and moisture. The new cylindrical, vessel-type reservoir has extra strength and the entire top is easily removed for thorough maintenance and easy servicing. There is a complete full-flow micronic filtering system.

"No stop" Full Power-shift Transmission: This HOUGH transmission was developed exclusively for rubber-tired tractor-shovel requirements and has been thoroughly proven on thousands of PAYLOADER units. All shifts, up or down, forward or reverse, can be made "on-the-go" with no stopping and engagement of gears needed for "range-shifts."

Sealed, 4-wheel Power Brakes: These powerful brakes are air-controlled with only touch-toe effort and are sealed against dust and dirt. Furthermore, the exclusive HOUGH axle design makes it possible to service and re-line the brakes without removing and exposing planetary hubs to dust and dirt. Another important HOUGH-pioneered feature is the "Operator's choice" dual brake pedals which permit braking with or without transmission engaged.

Positive Oil Cooling: Separate fan-cooled oil-to-air radiator assures positive cooling of both transmission and torque converter oil. Another exclusive HOUGH protective feature.

"Power-transfer" Differentials: Both axles are equipped with torque-porportioning differentials. When one wheel has better traction than the other on the same axle, it can automatically receive up to 38% more torque. This assures the best possible traction at all times.

The new H-60 model is offered with a choice of gasoline or diesel power and with buckets from 1⅛ to 3½ cubic yard capacities. (S.A.E. rated) For additional information and specifications, see your HOUGH Distributor or use the attached coupon.

THE FRANK G. HOUGH CO. 10-B-1
726 Sunnyside Ave., Libertyville, Ill.

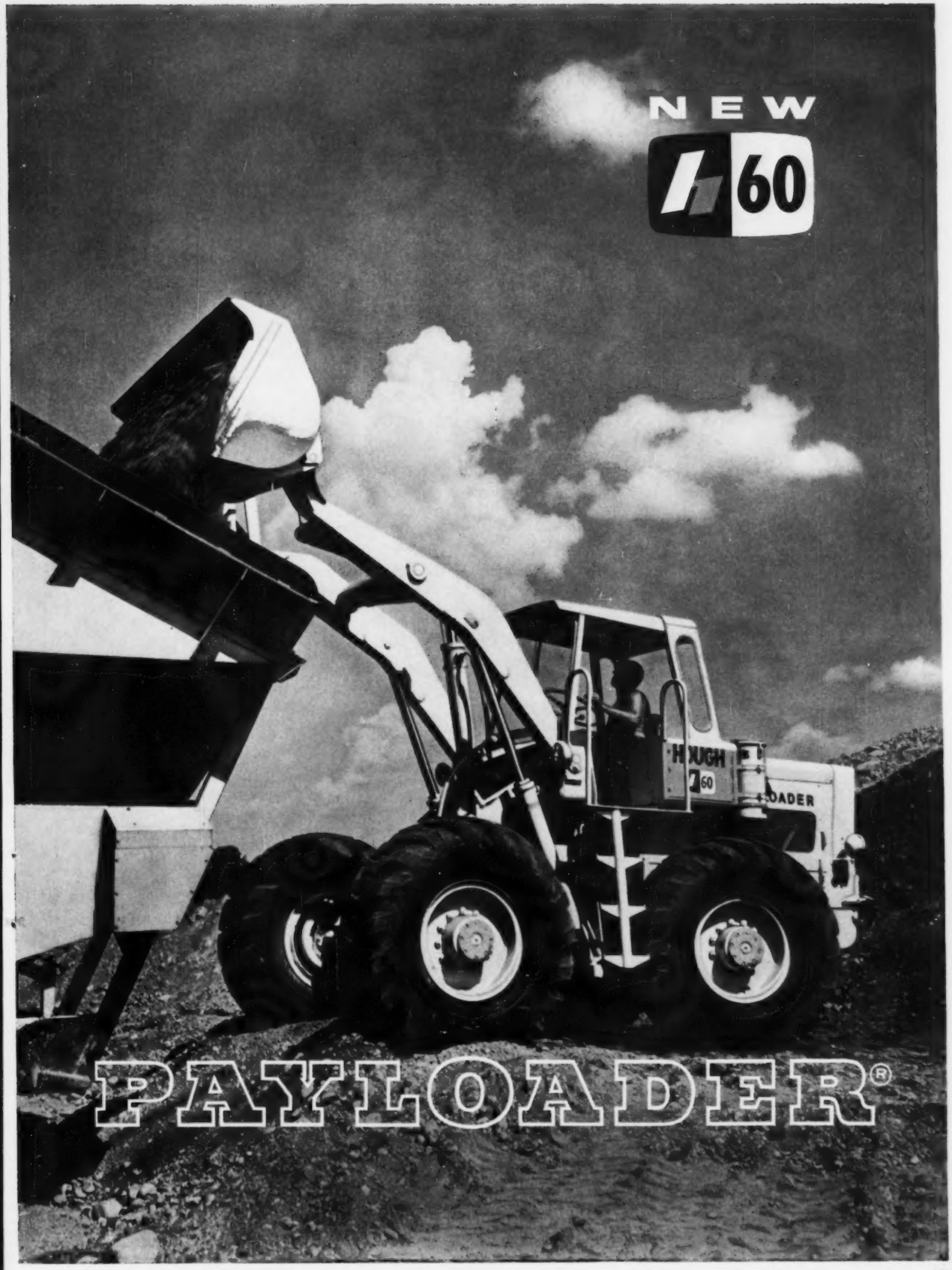
Send full data on all-new Model H-60 "PAYLOADER"

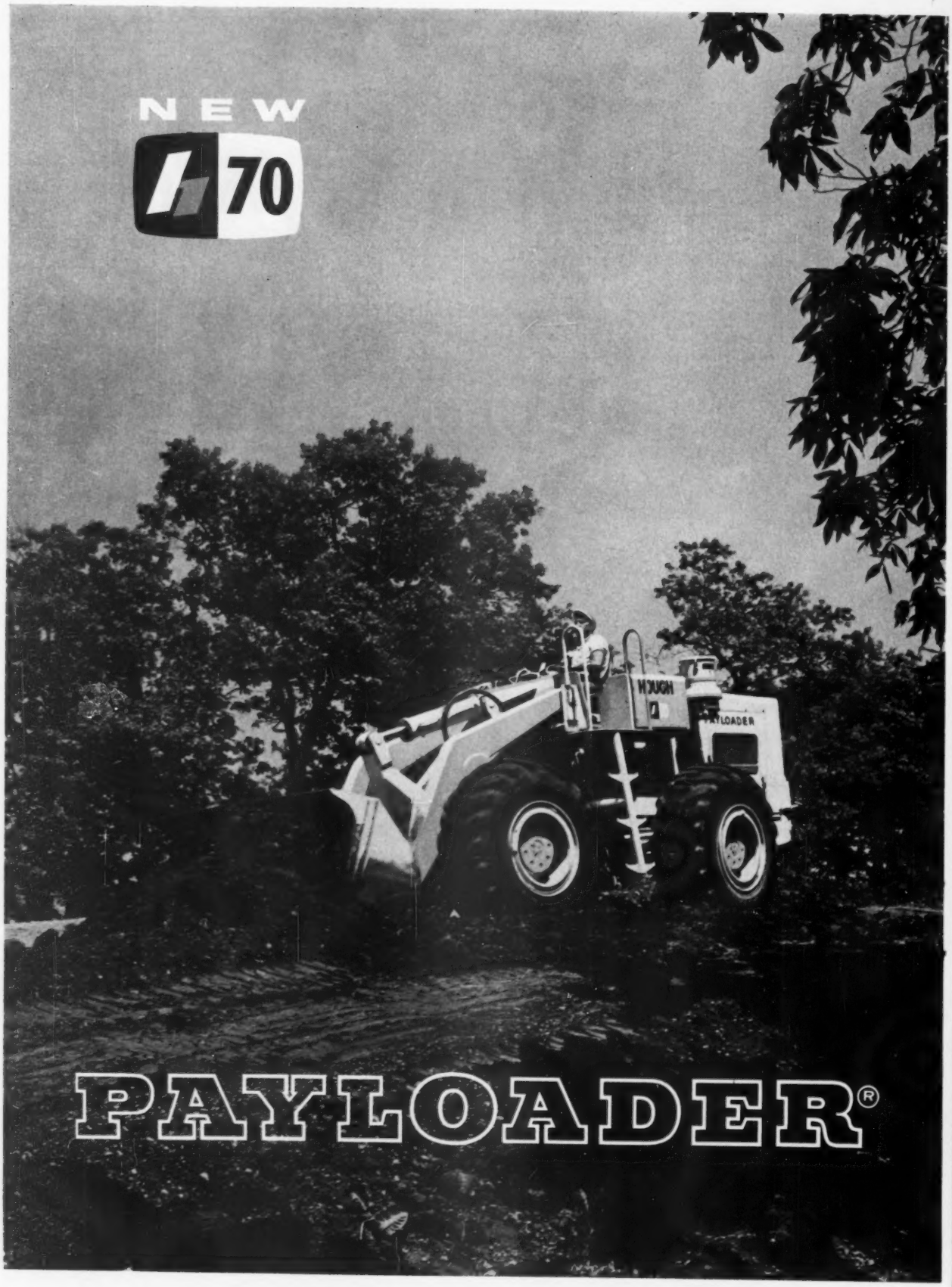
Name _____
Title _____
Company _____
Street _____
City _____ State _____

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYDOZER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.


NEW
60
PAYLOADER®


NEW
70
HOUGH
PAYLOADER
PAYLOADER®

No. 3 in a series of announcements on new HOUGH *machines*

The new 2½ cu. yd. PAYLOADER

has everything

say users after long and severe testing under a variety of job applications

The advanced design and exclusive features of this new H-70 series "C" model were subjected to many months of continuous, rugged testing by users on actual job-site locations before final evaluation.

Those items which contributed the most to the unmatched performance of the smaller H-30 and larger H-120 four-wheel-drive PAYLOADER models during the past two years served as a guide for the development of this completely new 2½ cubic yard tractor-shovel.

By comparison with the previous model, the H-70C has increased capacity, more power, greater flotation, additional reach, easier handling, simplified maintenance, new safety features and vastly superior performance. Some of the features are:

More Capacity: An increase of 25% in the size of the standard bucket, from 2 to 2½ cubic yards. (S.A.E. rated) Optional buckets from 1⅜ to 5 cu. yds. are available.

More Power: The new heavy-duty diesel engine delivers 148 hp which is an increase of 20% over the previous model. This gives the H-70C more horsepower per pound of machine weight than any comparable machine.

Safety and Convenience: All bucket and boom mechanisms are located ahead of the operator compartment for maximum protection. The steeply-sloped cowl and open design give 100% visibility. A comfortable, adjustable bucket seat and conveniently located controls make operation easy. Safety ladder and hand rails provide easy access to the walk-in driver compartment.

Less Maintenance: The only loader in its class with simplified PAYLOADER boom mechanism and single bucket tilt cylinder. This means you have from 4 to 10 fewer pivot and grease points and fewer parts to service and maintain. In addition, all pivot points on steering, boom and bucket mechanisms are fitted with "O" rings and other seals which keep grease in and dirt out to provide longer life and less maintenance.

"Keep-clean" Hydraulic System: A valuable, exclusive HOUGH feature is the closed and pressure-controlled hydraulic system to keep out air-borne dust and moisture. The new cylindrical, vessel-type reservoir has extra strength and the entire top is easily removed for thorough maintenance and easy servicing. There is a complete full-flow micronic filtering system.

"No-stop" Full Power-shift Transmission: This HOUGH transmission was developed exclusively for rubber-tired tractor-shovel requirements and has been thoroughly proven on thousands of PAYLOADER units. All shifts, up or down, forward or reverse, can be made "on-the-go" with no stops for any "range-shift" engaging of gears.

The H-70 series "C" has many other proven HOUGH features including a separate fan-cooled, oil-to-air radiator for effective cooling of both torque-converter and transmission oil; torque-proportioning differentials for better traction; "operator's choice" dual brake pedals which permit braking with or without transmission engaged. For complete information on the tractor-shovel that "has everything" see your HOUGH distributor or use the coupon.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYDOZER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.

THE FRANK G. HOUGH CO. 10-B-2
726 Sunnyside Ave., Libertyville, Ill.

Send complete data on H-70C PAYLOADER

Name _____
Title _____
Company _____
Street _____
City _____ State _____

Trace mineral recovery your problem?

. . . investigate General Mills LIX reagents. These reagents have been proven commercially as organic extractants for metallic anions from aqueous leach liquors. First developed for hydrometallurgical recovery of uranium, LIX reagents produced a high quality product for a fraction of the normal processing cost.

General Mills liquid ion exchange system is also used commercially for the extraction of vanadium and tungsten. It also holds excellent promise for economical extraction of cobalt, molybdenum, columbium, tantalum, zirconium, hafnium and certain rare earth separations.

Flotation reagents for the recovery of non-metallic ores are available under the trade names Alamine® (primary fatty amines) and Alamac® (acetate salts of fatty primary amines). And, in addition to supplying standard reagents, General Mills sales engineers will be happy to collaborate with you in developing custom amine compounds to meet your specific operating requirements. For research samples of current LIX reagents and application literature, write the *Market Development Department, Chemical Division, General Mills, Inc., Kankakee, Illinois.*

General Mills **CHEMICALS**

Versamid® Polyamide Resins, GenEpoxy® Resins, Genamid® Epoxy Curing Agents, Fatty Nitrogen Chemicals, Deriphat® Amphoteric Surfactants, Steroids.

NEW RPM
DEPOSIT-FREE
MOTOR OILS

Now new RPM SPECIAL joins RPM SUPREME to cut the cost of your fleet operation no matter what grade of oil you use.

RPM Supreme was the first multi-grade motor oil with an **ashless detergent.** Now it's matched with new single-grade RPM Special. Both halt engine wear, keep combustion chambers so clean — rings, screens and crankcase so free of sludge that you get far longer engine life.

Result: you can save hundreds of dollars in overhaul costs . . . get cleaner, smoother engine performance for your fleet. Even under the toughest operating conditions, you'll be money ahead when you choose from the only complete line of deposit-free motor oils:

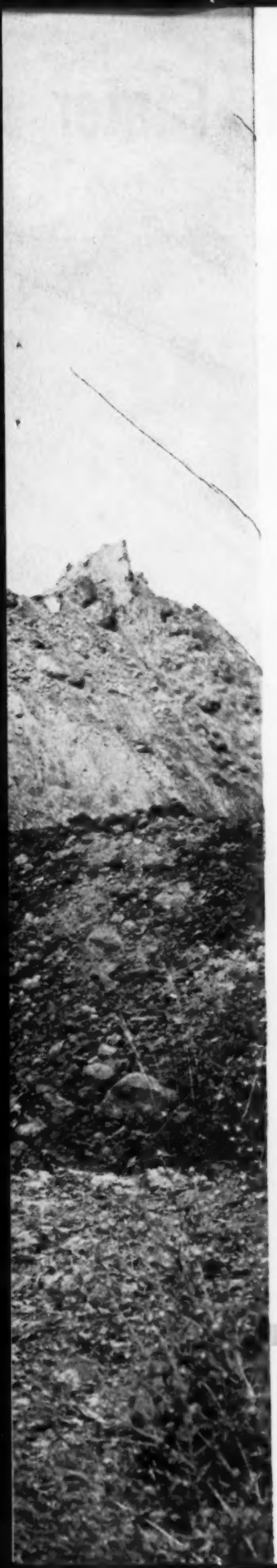
UNSURPASSED RPM SUPREME...an all season multigrade oil that cuts friction so effectively it saves up to 15% on gas . . . gives far easier starting.

NEW RPM SPECIAL . . . the only single grade deposit-free oil available.

For real engine economy in passenger cars, light and heavy duty gasoline trucks, ask our local representative about RPM *deposit-free* Motor Oils or write any company listed below.

MOTOR OILS
RPM

STANDARD OIL COMPANY OF CALIFORNIA San Francisco 20
STANDARD OIL COMPANY OF TEXAS El Paso
CALIFORNIA OIL COMPANY Perth Amboy, N.J.—Denver



DOZING PACEMAKER IN HIGH GEAR

For stripping overburden, the Allis-Chalmers HD-21 with wide range transmission is in a class by itself. This tractor moves bigger loads over a wider speed range, than any other machine in its price range.

Ever stop to think about the difference just 1 or even ½ mph can make on long stripping operations, pioneering, road maintenance and cleanup work? For example, an Allis-Chalmers torque converter HD-21 averaging 3 mph dozes 60 miles every time a comparable-sized machine averaging 2.5 mph dozes 50.

And you'll get this speed advantage with an HD-21 on jobs like those above that you can handle in this tractor's wide range high gear. It gives you a speed spread of 0 to 6 mph. Using only this gear, the operator can do more work in the 1.75 to 4.5 mph range than comparable units can do in three gear ranges. And for heavy dozing, the HD-21's low gear gives this tractor the big load power in the 1-to 2-mph range.

But it's more than just raw speed that makes the HD-21 a big-production dozer. It's stability with the long track that smooths out tractor bounce. It's fast acceleration with the best engine-torque converter combination in the industry. It's precise control with quickly responsive levers and a tight-fitting, close-coupled blade. At top mph, the HD-21 dozer can hold a level grade which "sloppy" dozers can't begin to match even at slow speeds. It's all these things that add up to low-cost dirt.

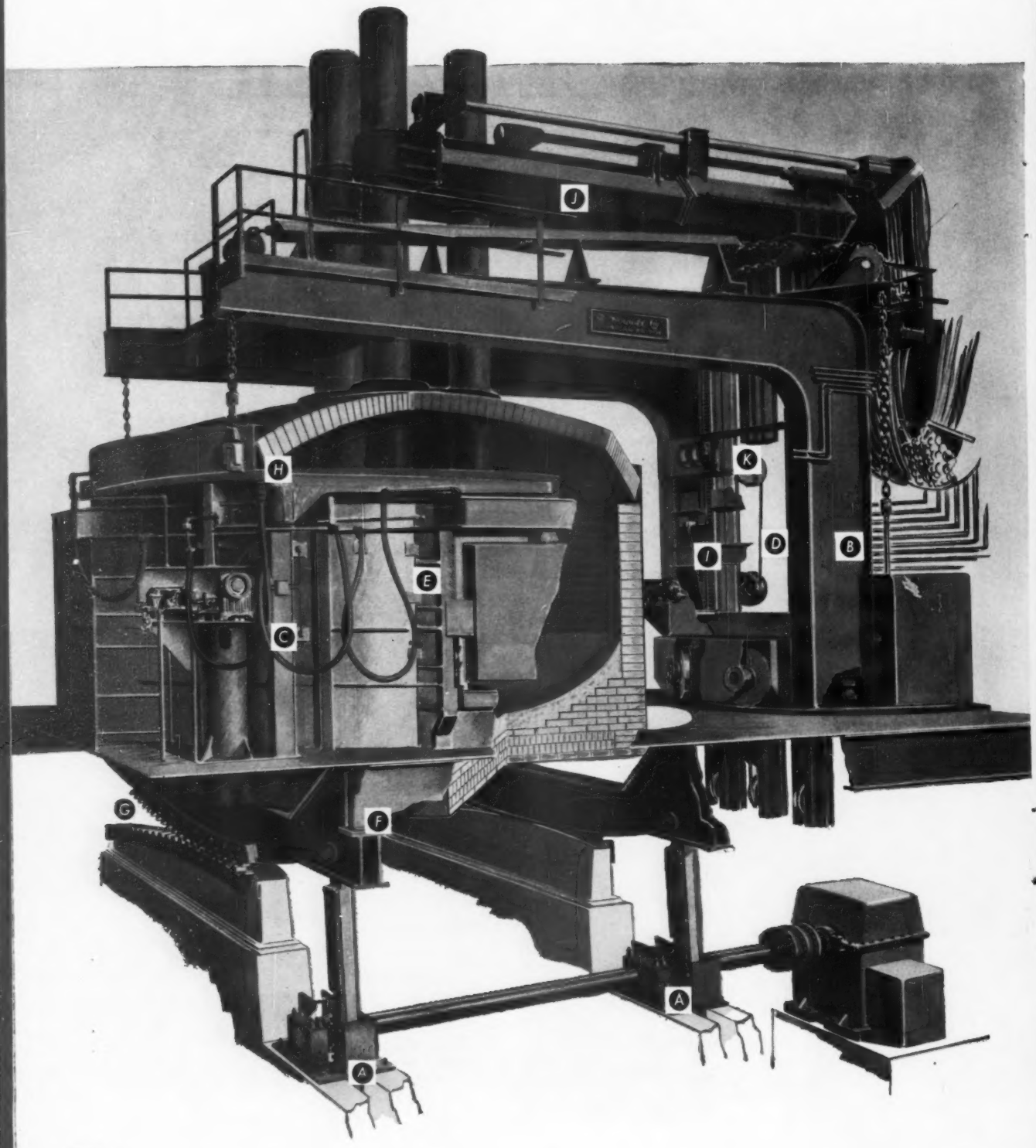
Your Allis-Chalmers dealer is confident that the HD-21 will give you more for your dozing dollar — not only with the workingest high gear, but also long-life oil steering clutches and brakes, the toughest track ever built . . . the industry's healthiest engine, certified permanent lubrication of truck wheels, unit construction for easiest maintenance. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

STEP UP YOUR

Performance
Operator comfort
Wearability
Ease of maintenance
Reliability

WITH **ALLIS-CHALMERS**
POWER FOR A GROWING WORLD

More Steel...Better Steel...Faster



This mark tells you a product is made of modern, dependable Steel.

with a Heroult Electric Furnace

You can increase your steelmaking efficiency and get better steel in the bargain with a Heroult Electric Arc Furnace. Here's why: Heroult Furnaces heat fast — make more melts per day. Heroult Furnaces lower costs through high yields per heat and small scrap losses in charging. And, Heroult Furnaces improve steel quality by reducing sulfur and phosphorous content.

If you're looking for performance, efficiency, economy and low-cost maintenance, consider these features:

1. Heroult Furnaces are 100% mechanically operated. Including **(A)** heavy rack-and-pinion-type tilting mechanism, **(B)** motor-driven, rotating, jib-type roof swing, **(C)** winch-operated, water-cooled, jib-type door-lift mechanism, and **(D)** high-speed, electro-mechanical electrode-positioning mechanism.

2. Cage-type shell construction with shell plates loosely attached **(E)** to heavy supporting structure. This construction minimizes shell warping and allows easy replacement of damaged shell plates.

3. Operating mechanism independently supported. The tilting platform on which all operating mechanisms are supported is attached directly to the rockers independent of the shell structure **(F)**. Thus, operating mechanisms are unaffected by shell distortion.

4. Water-cooled, Skew Back Roof ring. This feature **(H)** eliminates the need for special skew-shaped roof refractories.

5. Electrode Mast Safety Device. This spring-loaded, rack-and-pawl-type device **(I)** provides positive protection against damage resulting from electrode winch cable breakage.

6. Square-section, Water-Cooled Electrode Mast Arms. This design **(J)** guarantees a rigid connection between mast and mast arm, thus helping to maintain proper electrode position.

7. Remote-Controlled Electrode Clamps. This device, of the spring-clamp, air-release type, is located inside of the rear section of the water-cooled mast arm where heat cannot affect it.

8. Square-Sectioned Electrode Mast. This design feature **(K)** developed by American Bridge, assures proper guiding and electrode positioning.

9. Rockers. The heavy fabricated steel curved top and bottom rockers **(G)** minimize forward travel during tilting. These rockers are designed so that the furnace will tend to return to horizontal position from any degree of tilt.

American Bridge constructs Heroult Furnaces for all types of arc melting, in charge capacities from 6,000 lbs. to 400,000 lbs. with shell sizes ranging from seven feet up. They are equipped with roof-removing mechanism for fast top charging. They can be furnished with a non-magnetic shell bottom section to accommodate induction-stirring equipment. Gantry-type top-charge furnaces, door-charge furnaces and special furnaces for duplexing and non-ferrous melting are also available. Your crew can easily maintain a Heroult Furnace. Check American Bridge's complete design, construction and installation service.

USS is a registered trademark

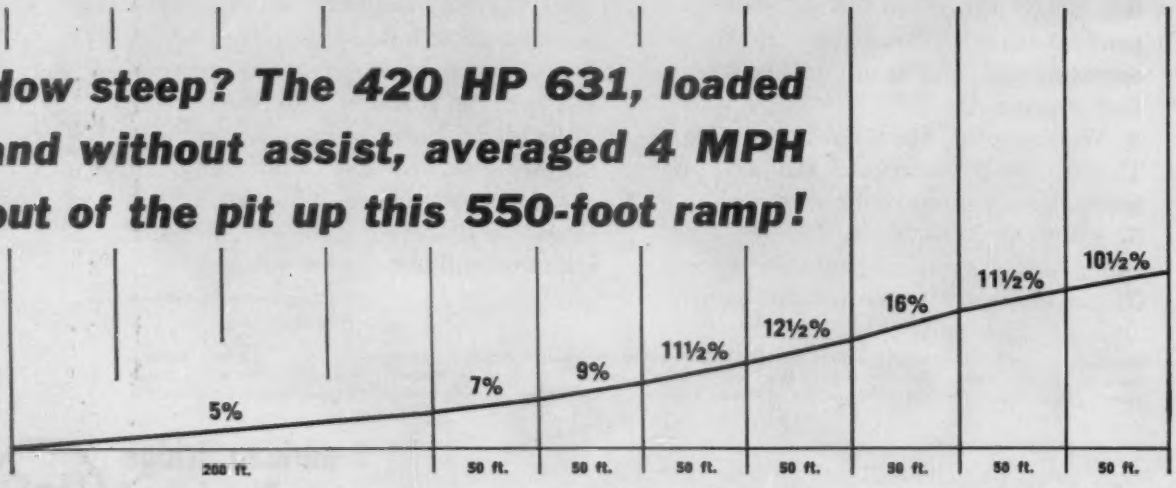
General Offices: 525 William Penn Place, Pittsburgh, Pa. Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati Cleveland • Dallas • Denver • Detroit • Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis • Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh • Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton • United States Steel Export Company, New York

American Bridge Division of United States Steel

USS

NEW POWER SHIFT TAKE STEEP GRADES

How steep? The 420 HP 631, loaded and without assist, averaged 4 MPH out of the pit up this 550-foot ramp!



The job: Stripping overburden for bauxite in Bauxite, Arkansas, for Dixie Contractors Inc., Memphis, Tenn.
Length of haul: 5400 feet one way, with the first 550 feet adverse grade.

CAT WHEEL TRACTORS IN STRIDE

This was no one-shot demonstration under favorable conditions. This was one of the many tough jobs where Caterpillar's Research Department placed 631s to field-test the production capabilities of these units. The results of this study particularly emphasize the value of Cat power shift on steep grades. But power shift pays off in other ways, too.

Matter of fact, it begins right in the cut. When the operator starts in load range, the scraper stays right with the pusher—doesn't pull away every time he raises the bowl to pump in a few more yards. When the scraper's packed full, he slips the shift lever into 1st range and steps on the accelerator. No spinning or bucking—it picks up the load right away. Depending on the grade, it shifts *automatically* up to direct drive . . . and then *automatically* to overdrive . . . or *automatically* down again as the steepness dictates. Topping the grade, the 631 quickly accelerates to hauling speeds, over 30 MPH.

That's because, unlike ordinary power shifts, the Caterpillar unit matches power *automatically* to job conditions. It gives you *three* types of drive—torque divider drive (25% of engine torque multiplied by the converter and 75% bypassing it), direct drive and overdrive—in each of three speed ranges.

In all, it provides nine different speed variations, but the operator need concern himself only with the three speed ranges and load range controlled by one lever.

Cat power shift—rugged yet simple

How rugged is the new Cat power shift transmission? Consider this. Although the concept for scrapers is new, much of the basic design is not. It's similar to the proven D8 and D9 power shift transmissions, which—over the past two years—have racked up thousands of hours of trouble-free operation. The main difference is in the arrangement of the exclusive torque divider, where a direct drive and overdrive arrangement have been added. Automatic shifting through these three types of drive is accomplished by a simple mechanical speed-sensing device and a hydraulic valve which actuates clutches. A shift indicator shows when to change speed range up or down as needed.

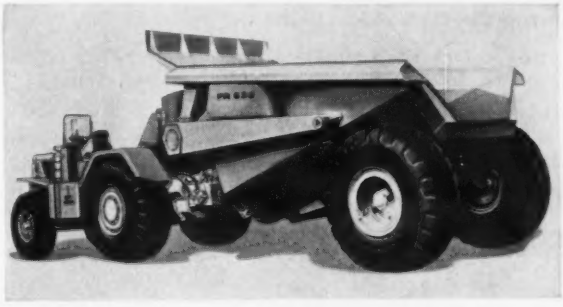
Full unit construction—easy servicing

Cat wheel Tractors give a smooth, stable ride . . . and they're easy to service. They feature full unit construction. Every major component can be serviced without disturbing adjacent units. Two examples: (1) The torque divider transmission is removable without disturbing the engine. (2) The fan is mounted on the radiator shroud for removal as a unit.

Two power shift 420 HP models—the 631 and 630

Which is best for your job—the two-axle 631 or the three-axle 630? Both are powered by turbocharged, aftercooled 420 HP engines. The 631, carrying 28 cu. yd. heaped, has a high usable speed of 31 MPH. The 630 has a usable speed of 41 MPH and is available with two scrapers—capacities, 28 yd. and 35 yd. heaped. For complete information about the new 631 and 630, see your Caterpillar Dealer. Ask him to prove how they can step up your production and lower your costs!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.



NEW ATHEY WAGONS . . . the 38-ton PR630 and PR631 Rock Wagons and 60-ton PH630 Coal Hauler are built by Athey Products Corporation for matched use with Cat wheel Tractors.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

PRODUCE MORE AT LOWER COST WITH POWER SHIFT CAT WHEEL TRACTORS

100,000-MILE WARRANTY FOR SUPER DUTY V-8's

THEY'RE HERE!

NEW '62 FORD TRUCKS

Get full-time economy that only starts with Ford's low price!

Meet the trucks that make saving money a full-time business—new Ford Trucks for '62!

In a selection of over 600 models there's a truck that's right for your job, whatever your job . . . trucks that you can buy and operate at lower cost . . . trucks that can save you money mile after mile, load after load, year after year!

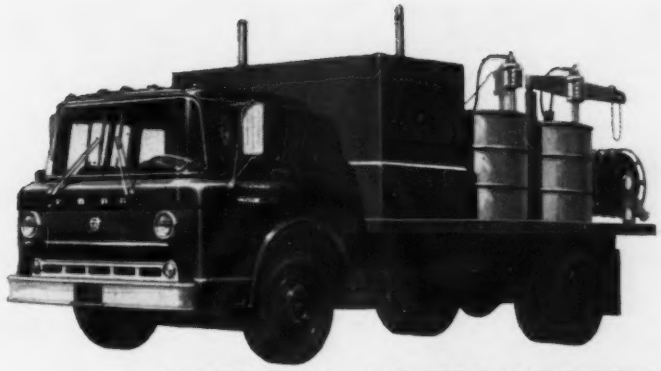
They save on price. They save on gas and oil. They save on tires and on maintenance—wherever there's a way to save! The full record of Ford economy, covering three years of independent tests, is detailed in Ford's Certified Economy Reports. See your Ford Dealer now. Check out the facts, work out a deal, and drive out a truck that saves money . . . full time!

FORD TRUCKS COST LESS

SAVE NOW...SAVE FROM NOW ON!

ECONOMICAL HEAVY DUTY V-8's with 292-, 302- and 332-cu. in. displacement give you tailored-to-the-job economy at much lower prices than you would expect in trucks with engines of this size. Stress-relieved cylinder heads, aluminum alloy pistons and sodium-cooled exhaust valves are but a few of the heavy-duty features you get with these engines.

EXCLUSIVE 100,000-MILE WARRANTY on 401-, 477- and 534-cu. in. Super Duty V-8's is the most liberal in the industry. Each major engine part (including block, heads, crankshaft, valves, pistons, rings), when engine is used in normal service, is warranted by your dealer against defects in material or workmanship. The warranty covers full cost of replacement parts for 100,000 miles or 24 months (or 3,000 hours if used as a power source for other than propelling the vehicle), whichever comes first . . . full labor costs for 50,000 miles, 12 months or 1,500 hours, sliding percentage scale thereafter.

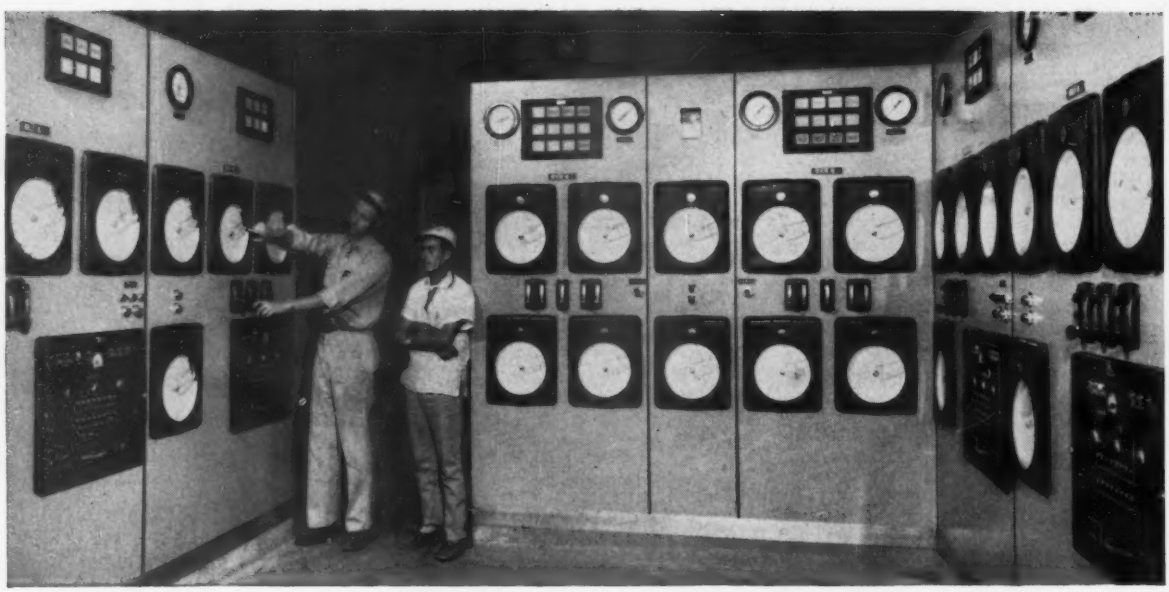


PROVEN 262-CU. IN. BIG SIX FOR FORD MEDIUMS includes more heavy-duty engine features than any other Six of its size. Never before such long-term durability, reliability, and economy at so low a price.

NEW STYLESIDE BODY FOR 4 X 4 PICKUPS— Ford's rugged 4-wheel drive models are now available with a cab-wide Styleside box that provides over 70 cubic feet of loadspace. Flareside body with running boards is also available.

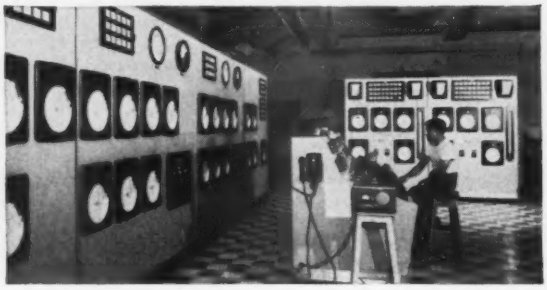
HEAVY-DUTY CAB, RADIATOR AND SHEET METAL—All Ford Tandems utilize heavy gauge steel, sturdy reinforcements and independent mounting systems to separate radiator, fenders and cab. This stronger construction, with each component individually frame-supported, gives long life, reduces maintenance expense and cuts downtime.

PRODUCTS OF Ford MOTOR COMPANY

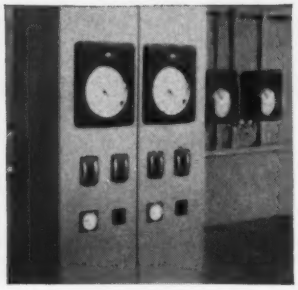


Controls for waste-heat boilers and reverberatory furnaces.

Lime kiln control panel.



Controls for combustion, feed water, and steam temperatures of power boilers.



Turbo-blower control and air flow meters.

At TOQUEPALA and ILO

. . . world's most instrumented copper plant

Every major process and power component at the Southern Peru Copper Corporation installation is overseen by a system of highly engineered instruments . . . sensing, indicating, recording, and controlling. This is one of the most complete networks found at any primary copper producing plant.

Prominent in development of this instrumentation has been the Bailey Meter Company. Some of the Bailey equipment is shown above. Other units include: gas analysis cubicles, converter controls, lime slaker controls, centrifugal blower controls, anti-reverse flow controls, differential level controls, and feed water, temperature, and level transmitters.

Bailey was a logical selection. For more than 40 years, they've lead the development of instruments and controls. And, as marked by Toquepala and Ilo, their scope is dramatically comprehensive.

Whatever your process-instrumentation need, Bailey is in a position to help. Check our capability. A Bailey District Office or Resident Engineer is in your vicinity. Refer to your phone book, or write direct.

C116-1

Instruments and controls for power and process

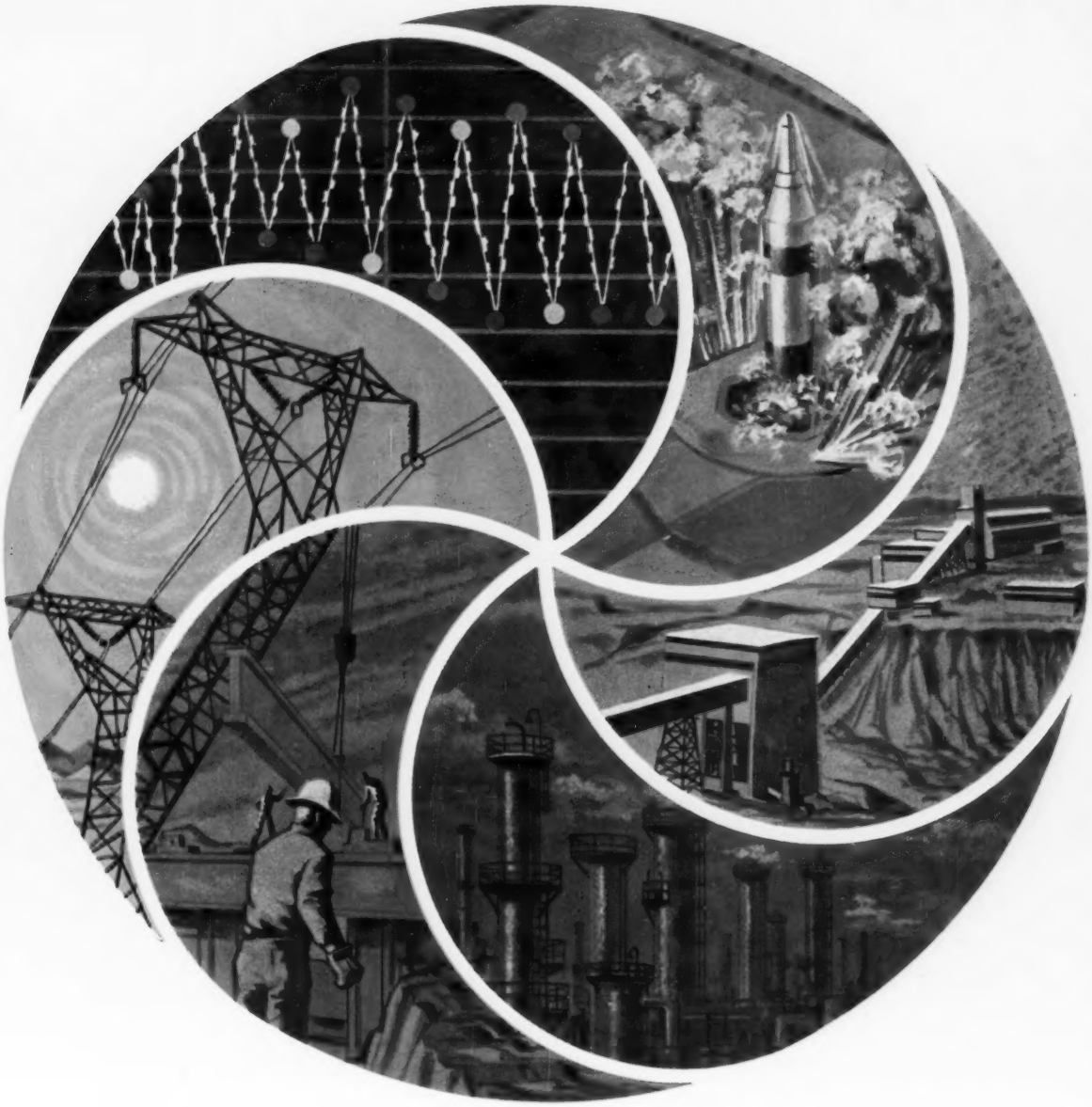
NONFERROUS METALS DIVISION

BAILEY METER COMPANY

1031 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS



TOTAL CAPABILITY...Single Source Responsibility

To Parsons, versatility means specializing in diversified fields. The breadth and depth of the Company's experience enables it to carry out the most highly specialized project with mature judgment and certainty of performance – *offering all the advantages of total capability... single source responsibility.*

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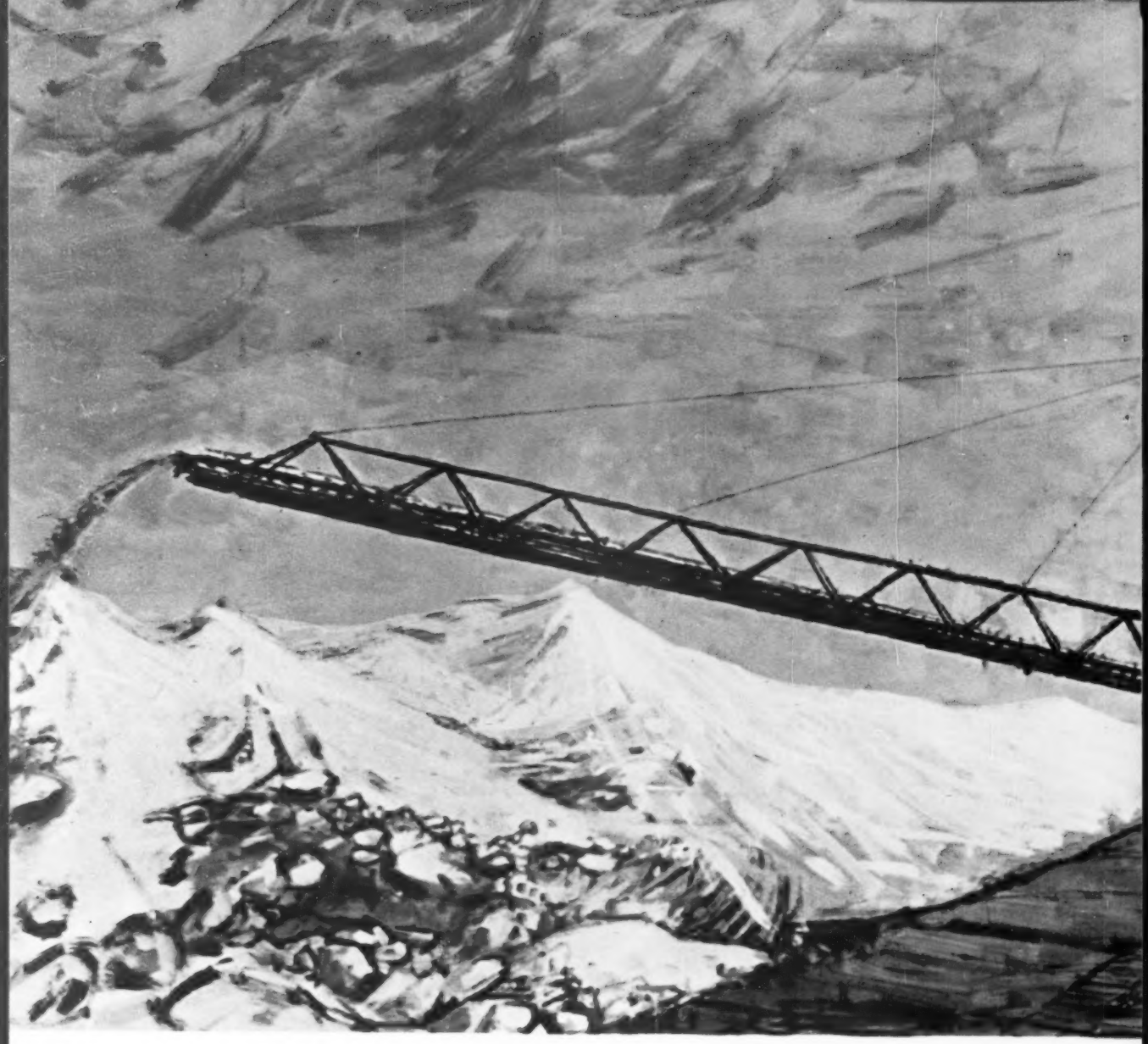
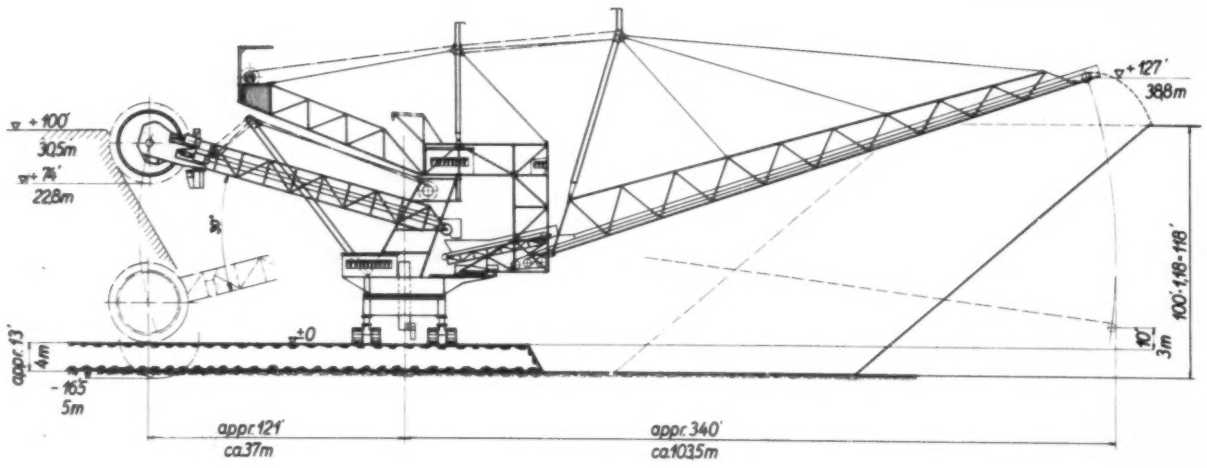
WORLD WIDE SERVICES: APPRAISALS AND ECONOMIC STUDIES • ARCHITECT-ENGINEERING • CONSTRUCTION • ELECTRONIC SYSTEMS AND COMPONENTS • MINING AND METALLURGICAL ENGINEERING • PERSONNEL TRAINING • PETROLEUM-CHEMICAL ENGINEERING PETROLEUM PRODUCTION SYSTEMS • PLANT OPERATION • POWER PLANT ENGINEERING • WATER DEVELOPMENT AND SYSTEMS




+100'
30.5m
+75'
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+127'
38.8m
appr.13'
4m
-16.5'
5m
±0
appr.121'
ca.37m
appr.340'
ca.103.5m
10'
3m
100'-110'-118'

3,000 ton wheel excavator for a North American mining operation

During the past five years a machine of similar capacity removed a total of 150 million cubic yards of dirt for a West German power combine. Operating around the clock, the machine averaged 100,000 yards a day.

We advise on all projects involving mining of minerals and their transportation. We develop complete surface and underground mining schemes and the necessary mechanical equipment, based on the broad experience of our mining and materials handling engineers.

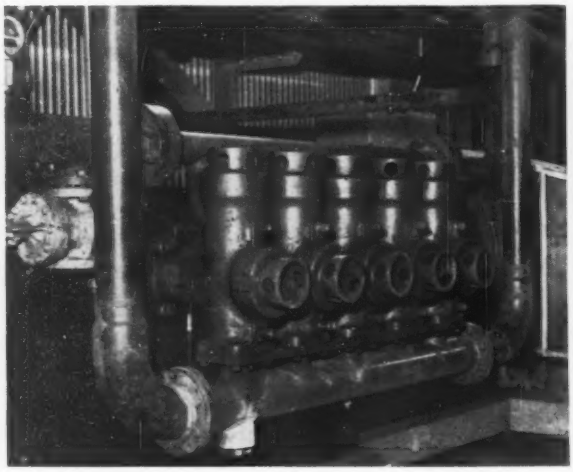
We design and build mining and construction equipment, including bucket chain excavators, bucket wheel excavators, loaders, spreaders, stackers, special equipment, complete bunkering plants, conveyor bridges, stationary and movable conveyors.

150 YEARS
KRUPP
1811-1961

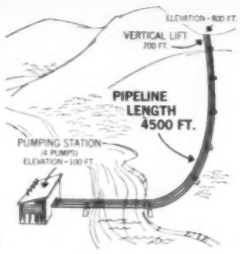
FRIED. KRUPP MASCHINEN- UND STAHLBAU, RHEINHAUSEN, GERMANY

In the Continental U. S. contact: KRUPP INTERNATIONAL INC., 375 Park Avenue, New York 22, N. Y.

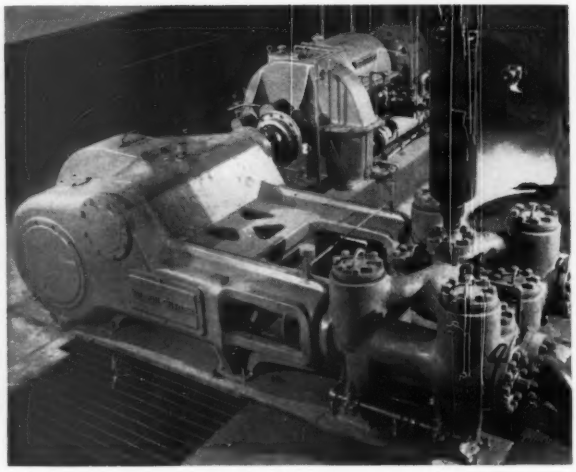
This mark tells you a product is made of modern, dependable Steel.



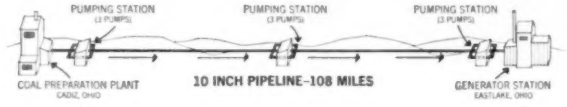
This short line carries waste materials in slurry form from a coal preparation plant to a disposal area—a distance of 4,500 ft. and a rise of 700 ft. Four Wilson-Snyder Quintuplex Power Pumps do the job.



Short Haul . . .



It's 108 miles between terminals on this line that carries coal in slurry form from Cadiz, Ohio to Eastlake, Ohio. Nine Wilson-Snyder Duplex Power Pumps do the moving. Line is operated by Hanna Coal Co. (Div. of Consolidation Coal Co.)



Long Haul . . .

Use Wilson-Snyder Pumps for high pressure slurry handling

The selection of the above installations emphasizes one important fact: Wilson-Snyder pumps are operating successfully and efficiently in both the long and short haul situations illustrated by these particular installations. It is important to know that Wilson-Snyder reciprocating-type pumps will perform successfully in applications involving the pumping of high pressure fluid-solids that cannot be handled by single-stage centrifugal pumps.

Wilson-Snyder pumps are available in a wide range of displacements, working pressures, and fluid-end designs and materials. Behind the successful performance of Wilson-Snyder pumps is the background and experience of Wilson-Snyder engineers, who are fully aware of the unique problems associated with each individual slurry pumping application. During the early planning stages of your slurry pumping installation, let Wilson-Snyder lend their experience and background to your engineers to be sure of selecting the most suitable pumping equipment . . . this means Wilson-Snyder. *USS is a registered trademark*

USS

Wilson-Snyder Works
Oil Well Supply
Division of
United States Steel

TODAY'S PATENTS

Tomorrow's technology

OLIVER S. NORTH

U.S. PATENTS

Metal and Mineral Processing

Processing of mixed nickel-iron ores: lower amounts of carbon are used and a dense, rather than sponge, nickel-iron powder is obtained; pulverized ore is preheated to the temperature of the metal oxide, and the preheated ore then heated to a higher temperature to reduce all the nickel oxide but not more than four times as much iron, thereby forming dense composite metal particles. A. E. Greene. U.S. 2,994,601.

Method for processing a pegmatite to obtain a heavy mineral fraction, $Be(OH)_2$, Li_3PO_4, K_2SO_4, and a silica skeleton residue useful as a catalyst support. A. M. Thomsen. U.S. 2,994,581.

Agglomeration of very fine ore concentrates, e.g. of taconite or chromite, or other metal-bearing materials, such as blast-furnace dust and pyrites ash. Powdered limestone or coke particles are coated with an inverse emulsion of hydrocarbon oils and then with a mixture of powdered pitch and cement. The ore or other fines are then blown onto the sticky base particles to build up balls or pellets. These pellets form porous masses when sintered. A. Subervie, U.S. 2,995,438.

Design for a pneumatic apparatus for cleaning, classifying and conveying freshly milled asbestos fiber. The fiber is not subjected to harsh mechanical handling. G. R. Russum, assigned to Johns-Manville Corp. U.S. 2,996,183.

E&MJ Monitor

Preferential reduction process for recovering nickel and iron from laterite ores of the Philippines, Cuba and other tropical countries. Pulverized dry ore is admixed with quicklime, common salt, and charcoal, and the mixture electrically smelted at 1500 deg. C. to collect a ferro-nickel alloy. Alumina cement is readily obtainable as a byproduct. M. Uemura, assigned to Tohoku Denki Seitetsu Kabushiki Kaisha. U.S. 2,995,-455.

Electrostatic beneficiation of clayey sylvinite or langbeinite ores or other potash-bearing ores or crystalline products from natural brines. Heated pulverized ore is treated with finely divided activated alumina or like pulverized solid, and then charged and electrostatically separated. G. L. Samsel, assigned to International Minerals & Chemical Corp. U.S. 2,997,171.

Improved three-step fluidized-bed direct-reduction process for iron oxide. A temperature of 1350-1550° F. is maintained in the first bed and 1050-1300° F. in each of the other two beds, whereby the product passing to the second bed is predominantly ferrous oxide and the product from the third bed is predominantly metallic iron. J. C. Agarwal, assigned to U.S. Steel Corp. US. 2,996-373.

Copies of U.S. Patents can be purchased at 25¢ each from the Commissioner of Patents, Washington 25, D.C.

A hydrometallurgical process for recovering zinc from zinc sulphide ore concentrates. The ore is reacted with aqueous H_2SO_4 to a pH of 0.5 to 2.5 at a temperature between 90° C. and the melting point of the sulphur in the presence of a free oxygen-containing gas and under a positive partial pressure above about 10 psi. Zinc is dissolved out of the ore as $ZnSO_4$, and the solution is separated and treated to recover elemental zinc. F. A. Forward and H. Veltman, assigned to Sherritt Gordon Mines Ltd. U.S. 2,996,440.

CANADIAN PATENTS

Exploration

A method for detecting the presence of electrically conductive underground orebodies. The field over the terrain is excited by a galvanic method, and anomalies are detected from an airplane by means of an electronic apparatus. The airplane flys a forward creep pattern. Low frequencies in the range of 60-2000 cycles per second are well adapted for locating base metal deposits. Various components in the electromagnetic field may be measured to give information about underground formations. B. S. Bjarnason. Aug. 8, 1961. Canadian 625,063.

Mining

A process for the solution mining of bedded mineral salt deposits. A shaft is sunk and drifts and crosscuts are driven. Drilling stations are then set up at intervals in the workings and small sections of the mineral bed dissolved and pumped to the surface. A. S. Dawson. July 25, 1961. Canadian 624,259.

Metal and Mineral Processing

In the recovery of cobalt, nickel, copper or zinc from aqueous solutions, the values are adsorbed as a metal amine complex by contacting the solution with a water-insoluble, solid weak base amine resin. The values are then recovered by stripping with a mineral acid solution and electrolyzing the stripping solution. W. C. Hazen, assigned to Kerr-McGee Oil Industries, Inc. June 13, 1961. Canadian 622,029.

In the production of weather resistant pellets of pyrites, sphalerite, antimony sulphides, or other sulphide ore flotation concentrates, the ore is admixed with bentonite and an elementary sulphur-containing material, the mixture pelletized, and the pellets dried, heated to about 70 deg. C. at atmospheric pressure in a drying oven, and finally cooled. B. Schaefer, R. Michels, K. Meyer and H. Rausch, assigned to Metallgesellschaft A.G. July 11, 1961. Canadian 623,800.

In the leaching of sulphide ores of copper, cobalt, nickel, zinc, cadmium, and other metals, a finely divided hydroxide of iron, aluminum, chromium or titanium is incorporated in the ore pulp passing to the leaching autoclave to lessen wear and corrosion of the equipment by forming a lubricating slime and diluting the acid. Slaked lime is not required to reduce corrosion. L. F. Clark, July 25, 1961. Canadian 624,271.

In the hydrogen reduction of iron oxide ores, a substantial degree of the reduction is accomplished with hydrogen at 750-1000° F., and the thus partially reduced particles are then reacted with CO_2 so as to deposit carbon on the particles. Finally, the carbon-coated particles are heated to 1300-1800° F. to complete the reduction. A. M. Squires, assigned to Hydrocarbon Research Inc. Aug. 8, 1961. Canadian 625,289.

Copies of Canadian patents can be obtained by writing to Commissioner of Patents, Patent & Copyright Office, No. 8 Bldg., Carling Ave., Ottawa.

Electrostatic apparatus for extracting gold from sand and gravel placer deposits without using water. Ore is fed over a drum covered with a surface layer of polyethylene plastic or other dielectric non-conducting material. Application of a non-fluctuating static surface charge attracts at least one component of the ore, while less strongly attracted materials are blown off. C. A. Phillips. Aug. 8, 1961. Canadian 625,101.

In the concentration of mineral values from mixed ores of copper, gold, manganese, chromium, vanadium, zirconium, tungsten or antimony, the ore is subjected to irradiation, whereby at least one of the component minerals is rendered radioactive. The radioactive material is then detected and separated. R. F. Errington and A. B. Lillie, assigned to Atomic Energy of Canada Ltd. Aug. 1, 1961. Canadian 624,778.

Design for a multi-cone apparatus for concentrating ores in a dry condition and in the absence of any chemicals. Minus 60-mesh ore is subjected to a "mechanical backwash" motion whereby the gangue particles are moved backwardly while ore particles are moved progressively forward. F. W. Hack, Aug. 8, 1961. Canadian 625,065.

NEW BOOKS

Keeping up with your profession

Fuel Cells—Power for the Future. Graduate students of the Harvard Business School prepared this technical and economic appraisal of developments and applications of the electrochemical fuel cell. Success of the fuel cell could have a dual impact on the mining industry: (1) If it replaces the piston engine, the lead industry could lose substantial markets for tetraethyl and batteries (about 40% of the total); (2) As an economic source of dc power the fuel cell could cut the price of certain metals ranging from 4% for zinc, to 10% for aluminum. Starting with a layman's description of the fuel cell and how it operates, this report goes deeply into the economic and technical feasibility of the application of the fuel cell to production of dc power, trucks, industrial trucks, automobiles, tractors, power shovels, off-highway trucks, light aircraft, locomotives, outboard motors, marine installations, central power units, home power and heat, and electrochemical production of metals. Research for this report has been assisted by some of the nation's leading industrial and military organizations vitally concerned about the fields listed above. Forward-looking mining executives will want to investigate this new power source which may have a powerful impact on the mining industry as we now know it. Published by Fuel Cell Research Associates, P.O. Box 157, Cambridge 38, Mass. 160 pp. Price $18.75.

Fluid Mechanics. by Richard H. F. Pao. Designed as an introductory text, this book uses a theoretical approach that presupposes a good knowledge of calculus. Rational approaches are used in developing fundamental equations of fluid motion. Many problems are included at the end of each chapter to supplement the text. Published by John Wiley & Sons Inc., 440 Park Ave. South, New York 16, N.Y. 502pp. Price $7.50.

Mineral Processing, by E. J. Pryor. This text, a revised edition of the author's "An Introduction to Mineral Dressing," has been developed to a more advanced level. Mathematical presentation has been strengthened, but the emphasis is on physical chemistry and scientific control. Recognition throughout the text of the economic pressure on technical operations when low-grade complex ores must be treated adds to the value of the book. Published by Mining Publications Ltd., 482, Salisbury House, London Wall, London, E. C. 2, England. 814 pp. Price $15.75.

Soviet Electrochemistry; Vol. 1, Kinetics and Polarography; Vol. 2, Oxidation and Reduction; Vol. 3, Applied, proceedings of the Fourth Soviet Conference on Electrochemistry. This significant conference, translated in English, covers reports on the latest Soviet progress in the field and the full texts of the most important papers presented. Vol. 3, for example, contains reports on applied electrochemistry, electrodeposition, nonferrous metallurgy, chemical source of current, and electrolysis in the chemical industry. Published by Consultants Bureau Enterprises Inc. 227 W. 17th St., New York 11, N.Y. Approx. 300 pp. in each volume. Price Vol. I, II, III—$15.00 each; three-volume set—$40.00.

The following publications may be obtained from Sales and Circulation Section, United Nations, New York, USA; or Sales Section, United Nations Office, Palais des Nations, Geneva, Switzerland:

Proceedings of the United Nations Seminar on Aerial Survey Methods and Equipment, Mineral Resources Development Series No. 12, Sales Number 60.II.F.5. Contains over 60 papers and summations presented at Bangkok under the Economic Commission for Asia and the Far East, Jan. to Feb. 1960. 167 pp. plus illustrations. Price US $3.00; 21/- sterling; Swiss francs 13.00.

Mining Developments in Asia and the Far East 1958, Mineral Resources Development Series No. 13, Sales No. 60.II.F.4. 37 pp. Price US $1.50; 10/6 sterling; Swiss francs 6.50.

Copper, Lead and Zinc Ore Resources of Asia and the Far East, Mineral Resources Development Series No. 14, Sales No. 60.II.F.8. 63 pp. Price US $2.00; 14/- sterling; Swiss francs 8.50.

THE MINERS DIGEST, published by R. W. Johnson. This weekly mining paper, which recently began publication, carries national as well as local mining news. Published every Friday at 327 E. Bennett Ave., Cripple Creek, Colo.

Black Gold, by Arthur Beeby-Thompson, with an introduction by Herbert Hoover. This entertaining and informative autobiography is a true fast-moving adventure story, written by a pioneer British oil man whose work and dealings with governments took him all over the world. Published by Doubleday & Co. Inc., 575 Madison Ave., New York 22, N.Y. 544 pp plus illustrations. Price $5.95.

Semiconductor Devices and Applications, by R. A. Greiner. Specifically designed as a text, and closely linking physics and characteristics of circuits, this new book is suitable for the senior or starting graduate student. A detailed description of switching circuits is presented. Published by the McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N.Y. 493 pp. Price $12.50.

Marinas, Recommendations for Design, Construction and Maintenance, second edition, by Charles A. Chaney. Published by the National Association of Engine and Boat Manufacturers, 420 Lexington Ave., New York 17, N.Y. 247 pp.

The World of Geology, edited and introduced by L Don Leet and Florence J. Leet. This is a brief description of geology for the laymen or for young people. Published by the McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N.Y. 262 pp. Price $4.25.

Modern Sulphur Mining (revised edition). This booklet describes the Frasch Process mines and statistical data of Texas Gulf Sulphur. Available from Texas Gulf Sulphur Co., 75 E. 45 St., New York 17, N.Y. 24 pp.

Montana Mining Law, by Koehler S. Stout, professor of mining engineering and attorney at law. This publication includes locating and patenting a claim, mining organizations and safety regulations. Published by the Montana Bureau of Mines and Geology, Montana School of Mines, Butte, Mont. Price $1.75.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

Niobium-Bearing Complexes East of Lake Superior, Ontario Dept. of Mines, Geological Report No. 3, by G. E. Parsons. Available from the Ontario Dept. of Mines, Toronto, Ontario, Canada. 74 pp plus maps.

Records of the Geological Survey of Tanganyika, Volume VIII, 1958. Printed by the Government Printer, Dar Es Salaam, Tanganyika. 113 pp plus maps. Price 17/50 Shs.

The following publications are for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Aerial Geology of the Little Cone Quadrangle Colorado, USGS Bulletin 1082-G, by A. L. Bush, O. T. Marsh and R. B. Taylor. 69 pp plus map.

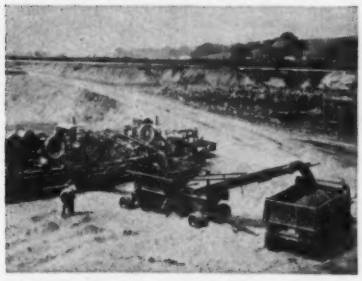
Anomalous Remanent Magnetization of Basalt, USGS Bulletin 1083-E, by Allen Cox. 29 pp.

Petrology of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation at Coal Canyon, Wyoming and **A Method of X-Ray Analysis for Determining the Ratio of Calcite to Dolomite in Mineral Mixtures,** USGS Bulletin 1111-C,D, by R. A. Gulbrandsen, 81 pp plus lithology charts.

Geology of the Maddux Quadrangle, Bearpaw Mountains, Blaine County, Montana, by Bruce Bryant, Robert George Schmidt and W. T. Pecora. USGS Bulletin 1081-C. 26 pp plus map.

NEW EQUIPMENT

Tomorrow's tools and methods

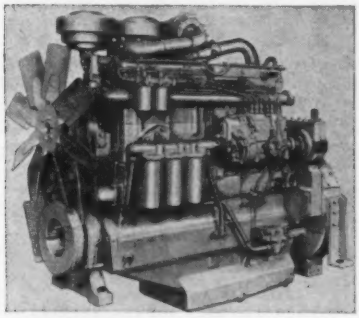


Portable Crushing Plant (36)

EXCLUSIVE RIGHTS for production and sale of a "Uni-twin" portable crushing plant, which offers twice the screening area of comparable size units, have been granted Lippmann Engineering Works by one of its distributors, Johnson Welding & Equipment Co.

Material on the 39 x 12 x 8-ft plant is moved from the feed end to discharge point continuously over screen sections. As a result, all finished material, including fines, is discharged without handling.

"Uni-twin" is available in a wide variety of combinations—with jaw crushers, jaw and roll crushers, twin roll or gyratory crushers.

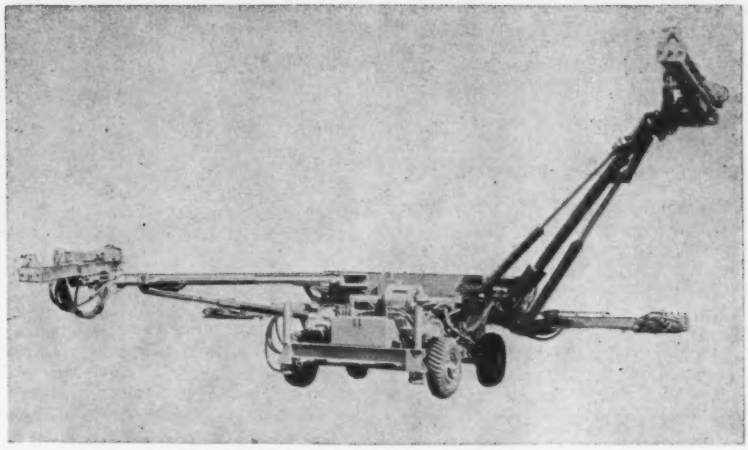


Small, Fast Engines (24)

NEW SERIES of small, high-speed diesel engines is being introduced by Fairbanks, Morse & Co. The new engines are well adapted for electric power generation and for installations where long periods of uninterrupted running are required.

All models in the 37- to 670-hp line operate at 1800 rpm, and the units up to 100 hp are available in speeds up to 2200 rpm.

Fairbanks, Morse calls the new line the Model 50A, and says that it has the following features: "open" combustion chambers, with toroidal cavaties in the pistons for complete combustion at all loads and speeds; individual injection system of C.A.V. or Simms make, depending on engine size; and low brake which means effective pressures together with high torque to enable the engine to operate at higher speeds without bogging down.



Joy Introduces Its Rotary Percussion Drill (17)

A ROTARY PERCUSSION DRILL, the Joy RPD, combines the best features of the two drilling methods, according to a recent announcement from Joy Mfg. Co. Because of the simultaneous rotary and percussive action, the company said, the new drill will penetrate most rock formations two to three times faster than any other drill.

RPD's rotary action is provided by an independent rotation system which applies high torque to the bit through a variable speed hydraulic motor and gear reduction. The percussion action comes from a high-speed, free-piston percussion unit.

Torque, feed pressure and hammering may be varied to meet drilling conditions, making possible higher drilling rates in mixed rock formations. RPD is best suited for tunneling and underground operations with holes 1¼ to 1¾ in. in dia up to 16 ft deep. Larger holes may be drilled in some formations.

The machine's piston strikes a relatively light, rapid blow which reduces shaking and vibration. This drastically lowers drill steel fatiguing, which means lower costs due to greatly increased drill steel life.

Some of the other advantages of the RPD are: maintenance cut to a minimum because of the simplicity of design; pressure and speed settings can be pre-set and easily altered for the type of drilling to be done; it uses either water or air to flush cuttings from the hole, about half the air required for a comparable 3½-in. percussion drill; and cycle time has been cut to as low as two hr, resulting in as many as four cycles per shift.

The Joy units may be mounted on jumbos or custom-designed drillmobiles. Each drill is elevated and positioned on a Joy Hydro-Drill Jib.

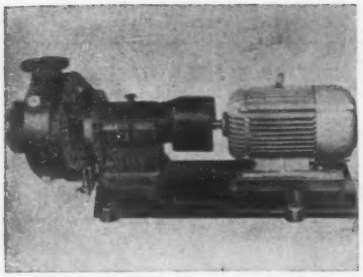
Hydraulic pumps are mounted on the carrier to supply pressure for positioning the drill, operating the rotation and applying feed pressure.

Level Indicator (9)

CORRECT LIQUID LEVELS can now be maintained by a simplified controller developed by The Ohmart Corp.

The new instrument can be applied to almost any size or type of vessel and provides continuous level indication or control. It uses the Geiger-Mueller principle of radiation detection and has sensing heads housed in thick steel tubes to meet explosion proofing requirements. Each head is 6 in. long and can be increased by 6-in. increments to meet specific applications.

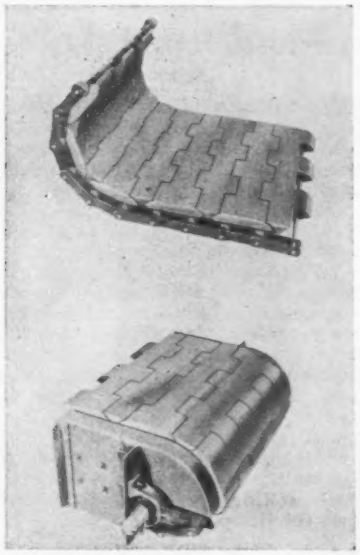
Ohmart's unit has no moving parts and is installed so there is no contact with the material being measured. High or low viscosity materials can thus be controlled without clogging either the material or the instrument.



Steam Jacketed Pump (38)

NEW STEAM jacketed acid pump, which will handle any solution freezing above ambient temperatures, has been introduced by A. R. Wilfley & Sons, Inc.

The pump's case, case plate and stationary seal ring housing have multiple steam line connections. In use, any two connections on each jacketed part are connected to the incoming and return steam lines. Steam connections are tapped for ¾-in. pipe.

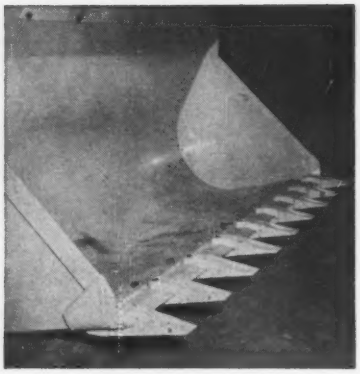


Interlocking Belt (6)

FLAT-TOP, HINGED-STEEL conveyor belting and flat-top belt conveyors are being introduced in a new line from May-Fran Mfg. Co., Div. of Fischer & Assoc., Inc. The belt's patented link design permits construction of a flat, continuous load-supporting conveyor surface for above floor and flush-with-floor installations.

The belt links interlock and overlap to give an almost smooth carrying surface. Through shafts, at each pitch, expand to join the side drive chains and position them. Intermediate connectors, which fit over the through shafts, are attached to the underside of the belt, tying the entire assembly into an integral rigid unit that is easy to assemble and disassemble.

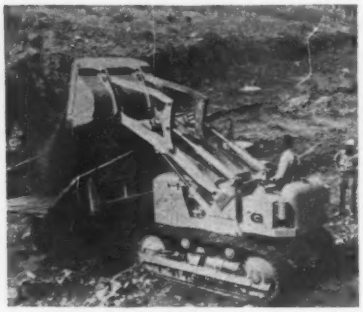
The interlocking design maintains closely fitted joints at all times, even while negotiating convex or concave curves. The belts can be supplied in any width from 12 to 60 in., and are available with 6- or 9-in. pitch links.



Longer, Improved Tips (3)

NEW, LONGER TIPS are now available for the bucket teeth of the three Caterpillar track-type loaders and the two larger Cat wheel-type loaders. The new tips have more steel at the wear zone and, according to Caterpillar, last up to twice as long in abrasive material as the previously-available shorter tips.

The improved tips come in two designs, runner and digger. The runner is designed for wheel loaders, and has additional material built into the bottom of the tooth. The digger type is for track-type machines which are likely to be used for excavation, resulting in maximum wear on the top side of the tooth. Both tips are flat on one side and ribbed on the other. Runner tips are mounted on the bucket rib side up; digger type, rib side down. Because the ribbed side wears slightly faster than the flat, the tip remains sharp throughout its useful life. Ribbing also avoids corner rounding; providing a straight leading edge across the full width of the tip at all times.



Improved Tractor Shovel (22)

FULL HYDRAULIC POWER steering and oil-cooled power brakes have been incorporated into Allis-Chalmers' new 1¾-cu yd capacity HD-7G tractor shovel.

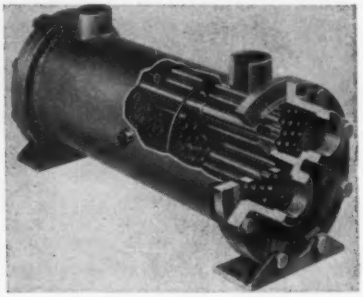
The HD-7G also has a single lever power shift transmission featuring the company's exclusive "Ground Speed Control" governor which allows the operator to pre-set any working travel speed to match job conditions.

A-C said the new machine's quick-mounted front attachments include: heavy duty rock bucket, rock fork, lift forks, straight and angling dozer blades.

Improved Blasting Agent (1)

ECONOMICAL new high density (1.2) blasting agent that attains a speed of 14,000 ft per sec has been developed by Austin Powder Co.

The agent, called Austinite 30, can be primed by using Austin ACP primers or regular dynamites and gelatins. Its higher density and velocity will permit wider spacing of blast holes or the use of a smaller quantity of blasting agent. It is offered in spiral wrapped containers, 4½ to 9 in. in dia. Similar packaging is available for Apcomite 30, a companion product with a self-contained primer.



Durable Heat Exchangers (8)

NEW LINE of heat exchangers, the Type 500, offers major advancements in design, engineering and construction, according to Basco, Inc.

The new exchangers use ferrous materials for shells, connections and bonnets to form an exceptionally strong and durable structure that withstands pressure surges and the corrosive action of synthetic oils and hydraulic fluids.

According to the company, the elimination of hubs overcomes the problem of leakage resulting from casting porosity and improper soldering and brazing.

Bore Hole Camera (20)

A SPECIAL CAMERA, the NX Bore Hole unit, which can obtain an accurate, oriented record from test holes as small as 3 in., has been developed by the US Army Corps of Engineers.

The small camera is housed in a 2 ¾-in.-dia stainless-steel cylinder which is 34 in. long and has a cable attached to one end by which it is lowered into the bore hole with a special winch.

The image enters the cylinder through a quartz window at the lower end, and is directed by a conical mirror upward into the camera lens. A compass and inclinometer are positioned below the mirror. A hole through the axis of the cone enables these units to appear in the center of frame.

The camera uses readily-available 8-mm color movie film which is exposed one frame at a time by flashing a strobe light as each frame moves into position. Both the film drive mechanism and the strobe light are synchronized with the winch mechanism at the surface so that 1-in. sections of bore are photographed at ¾-in. intervals as the camera is raised in the hole. Therefore, every in. on a 75-ft borehole can be recorded in full color on a single roll of double 8-mm film with compass and drift orientation in each photo.

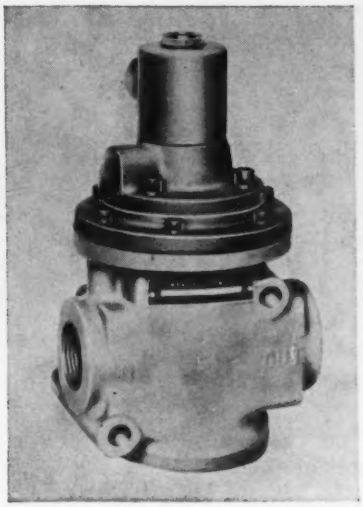
Necessary auxiliary equipment, in addition to a lowering device, field viewer and projector, includes a generator, a special hook for retrieving the camera in case of loss, and an empty dummy camera which is lowered into the hole to test clearance.

New Beryllium Detector (40)

BOULDER SCIENTIFIC CO. has introduced another beryllium detector. This one is portable and is ideally suited for one-man beryllium detection in the field.

The instrument, the Model 300 portable beryllium detector, uses the same nuclear reaction incorporated into Boulder's other beryllium spotters.

The 300 has an accuracy of from 1.0 to 5.0% of BeO percentage, depending on the concentration of beryllium in the sample. It will detect as little as 0.01% BeO, which, with a 50 millicuriex source, will give several counts per minute above background. The background is approximately 15 to 20 counts per minute at an altitude of 5000 ft.



Air Control Valve (19)

NEW, 1-IN. poppet type, two-way in-line air control valve is being offered by Hoffman Valves, Inc. It is available either normally open or normally closed and is intended for on-off control where air is used for processing or fluid power applications.

The valve is designed for service from vacuum to 200 psig. and is available in ¾-, 1- and 1¼-in. NPT port sizes. According to Hoffman, some of the valve's features include: removable and reversible seals, fewer parts, standardized parts interchangeable with the parts of other valves in the line, and full cushioning of moving parts to prevent impact damage. Other Hoffman advances include short stroke design, quick operation and high flow capacity.

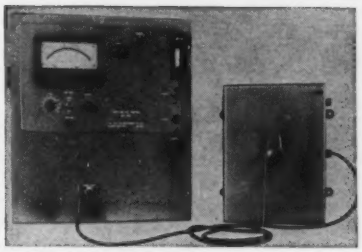
E&MJ Monitor

More Powerful Diesel (4)

A MORE POWERFUL VERSION of the naturally-aspirated Thermodyne diesel engine, but which is almost as light as the older model, has been developed by Mack Trucks, Inc.

The 180 hp in the new PowerRam Thermodyne diesel was made possible through use of a new air intake principle which increases volumetric efficiency by a full 10%. A. G. Crokett, vice president and general sales manager, said highly efficient manifolding, used in combination with a matching fuel pump, adds 10 hp to the basic naturally-aspirated END-673 engine.

The new system increases the intake valve air pressure by a pulse or ram principle which improves the engine's breathing capacity, and, according to Mack engineers, this permits the burning of more fuel for greater power without appreciably increasing engine weight.

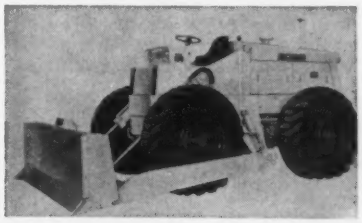


Carbon Monoxide Sampler (25)

GELMAN INSTRUMENTS CO., has developed an analyzer which, in just a few seconds, can determine any concentration of carbon monoxide. As a continuous analyzer, it can be used to check the gases in heat treating operations, to monitor carbon monoxide concentration in air pollution studies, to monitor exhausts in underground operations, and as a safety device in chemical plants.

The mixture of gases to be analyzed is passed through a tube with optical end windows transparent to infrared radiation. This tube and a similar reference tube are placed side by side between an infrared radiating filament and an infrared detector. The radiation through these two tubes is detected and compared. The difference is then displayed on a scale reading directly in percent of carbon monoxide.

Gelman's 60-lb analyzer can be used for sampling from compressed gas lines or from open air. It is available with an integral sampling pump, flowmeter, and pressure regulator. A jack is provided for connection to a standard strip chart recorder for continuous records.

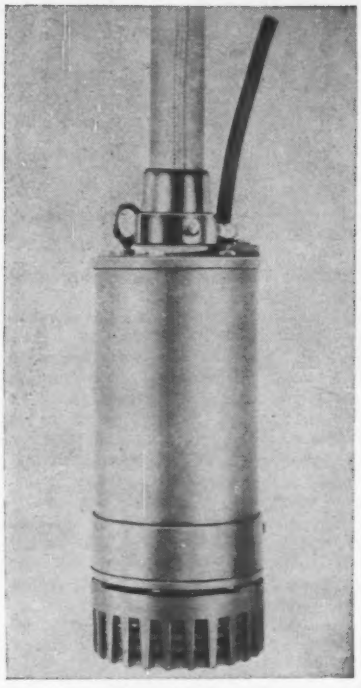


New Tractor Dozer Engine (7)

THE "MICHIGAN" Model 180 tractor dozer now is supplied with a 170-hp General Motors diesel engine as optional equipment, according to the Construction Machinery Div., Clark Equipment Co. The new engine, GM's Model 6V53, increases the tractor dozer's flexibility and production.

The new engine, GM's Model 6V-53, has a two-stroke cycle and unit injector fuel system, and increases the tractor dozer's flexibility and production.

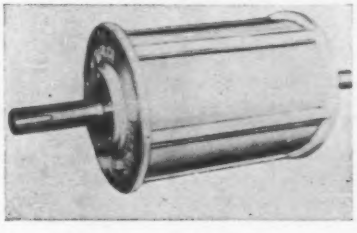
Model 180 has a top speed of 27 mph in forward or reverse. The drive line consists of a Clark construction type three-to-one multiplication factor torque converter, four-speed power shift, and all-wheel drive. Dozer blade action is all hydraulically controlled through lift, pitch and tilt cylinders. The pump is gear type, driven from the flywheel by a splined PTO shaft through the torque converter.



Submersible Pumps (21)

SMALL, PORTABLE ¾-hp submersible pumps which are safe, odorless, quiet, and which require no priming or adjusting, are being marketed by Prosser Industries. They can be operated wet or dry from a single phase 115v power line or an auxiliary 1000-watt generator and handle up to 120 gpm.

According to Prosser, the football-sized, 20-lb pump has precision prelubricated ball bearings, double shaft seals, fused circuits and a special anti-corrosive coating.

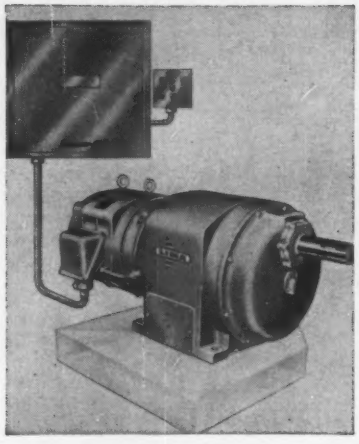


Magnetic Separators (5)

RECORD NEW VOLUME CAPACITIES are possible with Eriez Mfg. Co.'s redesigned and expanded line of permanent magnetic drum separators for eliminating tramp iron contamination.

The largest drums, 30 and 36 in. in dia, efficiently remove all large and small iron particles from a wide variety of materials—even when flowing at rates up to 25,600 cu ft per hr.

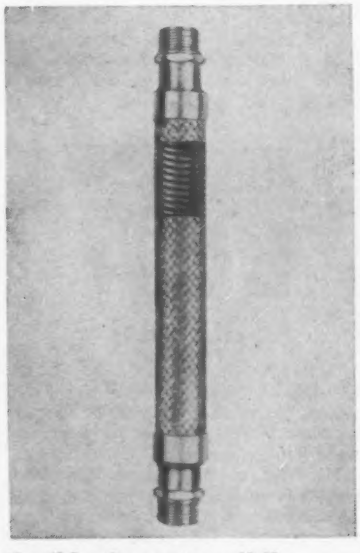
The company's new line includes standard models with 12 to 36-in. dia and widths from 8 to 60 in. In addition to standard units, new heavy-duty drum separators provide a heavier shell, abrasion-resistant end flanges and more rugged housings for long operation.



Remote-Control Drive (2)

NEW SIX-SPEED DRIVE, with hydraulic clutches activated by electric solenoids that shift to any of the speeds while running under full load, has been introduced by The Lima Electric Motor Co., Inc., subsidiary of Consolidated Diesel Electric Corp.

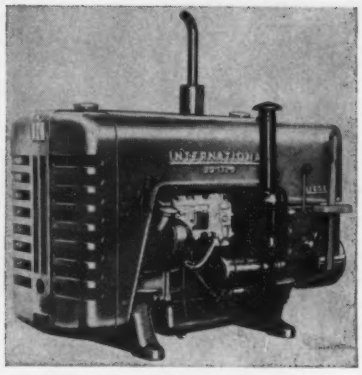
The drive, SELECTRO-SHIFT, is available in 20-, 25-, 30- and 40-hp and can be operated in either reverse or forward position in all six speeds. Shifting is controlled by an electric push button station which can be installed at any required distance from the drive.



Flexible Connectors (16)

AN ALL-METAL flexible connector, the UC3, which carries gases and fluids at temperatures up to 750°F, has just been introduced by Universal Metal Hose Co. The UC3 contains bronze and carbon steel—stainless steel versions can operate in temperatures of from 850 to 1400°F.

UC3 has a braided outer cover and a corrugated inner tube for combined flexibility and extra strength.



Small German Diesel (23)

INTERNATIONAL HARVESTER CO.'S Construction Equipment Div. has begun importing small diesel engines built at its subsidiary factory at Neuss, West Germany.

The Neuss-built engines, ranging from two to four cylinders, supplement the International line and do not replace any existing U.S.-built engines.

The imports are direct-starting, valve-in-head, sleeved engines with 19.1 compression ratios, and range from 15.8 to 39.6 maximum horsepower. They are designed with interchangeable connecting rods, main and connecting rod bearings, valves, valve springs, push rods, and rocker arm assembly components.

C. E. Jones, International's engine sales manager, said the Neuss engines are ideally suited as power sources for water pumps, generators, conveyors, lift trucks, compressors, locomotives and small crushers.

Retractable Air Leg (18)

NINE FOOT RETRACTABLE air leg, the Long Tom, is the only air leg that relieves the operator of the burden of steadying the drill in operating position, according to Machinery Center Inc.

Long Tom consists of a balancing air cylinder and an extendable air cylinder. By adjusting a four-way pressure valve which regulates air in the balancing cylinder, the operator can retract the drill, partially extend it, or extend it the full nine ft.

Machinery Center's new machine, costing about one fourth the price of a drifter drill, will do more drilling with less fatigue to the operator—more holes, faster, and at less cost per hole, on a less expensive machine.

OPERATING BULLETINS

Free aids to better planning

STEPHENS-ADAMSON MFG. CO. has published a brochure describing their "Solid Stroke" variable rate mechanical vibrating feeder. The company says the new feeder is the only vibrating unit offering a solid drive connecting rod controlling amplitude of stroke and insuring constant flow of material with any setting regardless of varying load.

AN ENTIRELY NEW mechanical vibrating unit—the industry's largest—is featured in Hewitt-Robins' eight-page Bulletin 169A. The heavy-duty ELIPTEX feeder consists of two parts; a vibrator and a one-piece pan weldment with or without grizzly section.

The company offers a line of 26 feeder, four slope sections—a total of over 100 basic selections. The new bulletin contains specifications, and charts for selection (width, length, slope), with selection factor and feeder capacity guide.

AN EIGHT-PAGE bulletin discussing Sturtevant dry processing equipment is now available from Sturtevant Mill Co. The company's full line of laboratory and production equipment is outlined, and the bulletin also includes information on the new fluor refining system.

NEW LINE of heavy-duty electronic air cleaners with push-button automatic control is described in a catalog from Westinghouse Electric Corp. The new catalog features the company's model PD Precipitron electronic air cleaners that are suitable for a broad range of industrial applications.

ALLIS-CHALMERS' Wedgtite tensioners for their cloth and plate deck screens are described in a recently-published bulletin (26B9995).

Complete instructions on how to apply the Wedgtite tensions are given in the literature along with illustrations of the necessary components. **(72)**

THE THIRTY-FIRST annual addition of the Flotation Index, covering 1960, has recently been published by Dow Chemical Co.

The Index is a bibliography of 517 articles which have appeared in mining publications, and the new edition is presented in a revised format for easier reference.

Material covering flotation research, general mineral dressing, and milling operations includes journal references listed alphabetically by journal title; patents listed alphabetically by country; books, documents, and symposia listed alphabetically by title; and individual items listed by subject. **(73)**

SPECIFICATIONS and a new price schedule for a complete line of general-purpose and special-use thermocouple assemblies and components appear in a newly revised 40-page catalog from Minneapolis-Honeywell Regulator Co. **(74)**

MOLYKOTE G is a grease-type lubricant containing a high concentration of molybdenum disulphide, and is one of the most effective lubricants known for extreme pressure applications, according to the Alpha-Molykote Corp. A new four-color, two-page Bulletin 131, describes Molykote G lubricating characteristics and gives application instructions. **(75)**

HUMOROUSLY illustrated 32-page handbook covering the care and handling of rock drill steels has been published by Atlas Copco. **(76)**

NEW BULLETIN covering the feeding, weighing, blending and proportioning equipment for the controlled feeding of liquids and solids, has been prepared by B-I-F Industries. **(77)**

LINE OF STOCK model compact heat exchangers is contained in Bulletin F-1161 from Basco, Inc. The bulletin describes a number of new construction features providing improved performance and reliability over a wide variety of applications. **(78)**

DETAILED fold-out brochure has been published by Caterpillar Tractor Co. to describe the new tips, teeth and shanks on Caterpillar Rippers, as well as dozer, scraper and loader cutting edges improvements.

One of Caterpillar's new features is the weld-on adapter for the No. 9 and No. 8 Rippers, allowing use of the new tips with all types of shanks. **(79)**

FEATURES that enable the Model 404 Trojan tractor shovel to deliver maximum production with fast, economical operation, are described in Yale & Towne's new specification sheet. **(80)**

THE VARI-TEX speed changer provides stepless changes within standard ranges of 2 to 1 through 10 to 1 at operating speeds from 1.8 to 4660 rpm. The unit's design features that provide dependable low-cost variable speed are described in Allis-Chalmers' Bulletins 51B9061B and 51B1042. **(81)**

COMPLETE LINE of single-stage, double suction, horizontal split case pumps made by the Aurora Pump Div., The New York Air Brake Co., is illustrated and described in the new eight-page Bulletin 105C. **(82)**

FULLY AUTOMATIC tramp iron separator, available in three types for suspending over conveyors, chutes or spouts, is presented in Bulletin 1206B-N from Dings Magnetic Separator Co.

According to Dings, the following features are new: deflector plate which bounces conveyor burden surge from cross belt to prevent stoppage; permanent, non-electric magnets fully enclosed in welded stainless steel housing; gear head, motor and drive is enclosed; belt facing and cleats on three-ply crossbelt are non-magnetic; and unitized construction which makes the separator ready for mounting and use without extensive installation requirements. **(83)**

THE NEW Ottawa LX backhoe for Caterpillar wheel loaders, with the Hydra-Hitch that makes it possible to remove or attach the unit to the loader in only 30 sec, is outlined by Equipment Div., Young Spring & Wire Corp., in a four-page, illustrated folder. **(84)**

WIRE ROPE conveyors for use above and below ground are described in Hewitt-Robins' new 24-page, two-color Bulletin 173.

Among the topics covered are basic types of head sections, belt take-ups, tail ends, auxiliary equipment and

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OPERATING BULLETINS (Continued)

newly developed components such as hydraulic tensioning units, belt winders, flexible idler stands, and utility tractors. **(85)**

CENTRIFUGAL PUMPS with special linings to handle most corrosive solutions from aluminum chloride to zinc sulfate are presented in an eight-page bulletin (No. 301) from Industrial Filter & Pump Mfg. Co. **(86)**

STEPHENS-ADAMSON MFG. Co. has developed a natural frequency vibrating conveyor with what the company calls an "exclusive variable stroke positive drive."

S-A says the new conveyors are the first of their type with a drive that provides infinitely variable conveying speeds from zero to maximum. All design features and specifications are contained in a new eight-page catalog. **(87)**

T. B. WOOD'S SONS CO.'S new Catalog 24103 contains three tables which give valuable information for those seeking replacement variable-speed belts. The first table, "Alphabetical Listing of Applications," lists all known manufacturers of equipment using variable-speed belts—manufacturer's belt part number is given with Wood's comparable number. The second table lists manufacturer's belt numbers and the corresponding Wood's number. The third table lists belts according to size—uses the new standardized numbering system which presents width of sheave groove in sixteenths, groove angle in degrees and belt pitch length in inches and tenths. **(88)**

NEW FROTH flotation cell, the Cyclo-Cell, is described in Brochure 861 published by Heyl & Patterson, Inc. The unit's outstanding feature, according to the company, is that it has no moving parts and is, therefore, extremely simple in design.

H & P said the cell gives low-cost, superior performance, and that it has recently been introduced into several leading coal and non-metallic mineral preparation plants. **(90)**

WELDING HANDBOOK which contains physical properties and analysis, and pertinent welding information on trade name steels such as USS T1 and T1 type A, SSS-100, the Jaoloy Steels, and other varieties, has been prepared by Alloy Rods Co. **(89)**

HOW TO control electric furnace fumes is explained in a new six-page bulletin from Pangborn Corp.

Detailed photographs and sketches show how Pangborn's new exhaust hood, combined with a synthetic-fabric dust collector, completely eliminates electric furnace smoke and fumes. The bulletin also outlines features of the system which enable it to operate efficiently even during oxygen lancing. **(91)**

COMPREHENSIVE chain lubrication manual has just been released by Oil-Rite Corp. The eight-page presentation gives general recommendations and suggestions for lubrication of power drive chains as well as conveyor and elevator chains. Special methods of chain oiling are also presented, ranging from plain manual brush-type lubricators to completely automatic systems. **(92)**

TDM-B2 Trac-Drill, a boom-mounted crawler drill for underground hard rock mining, is described in a four-page bulletin from Joy Mfg. Co.

Joy said the unit drills toe holes as low as 18 in. or horizontal holes as high as 13 ft, with lateral drilling range of 15 ft. All operating functions of the TDM-B2—tramming, positioning and drilling—are performed by one man from a conveniently located control station. **(93)**

DATA on Solnus "C", a general-purpose lubricating oil recommended for extremely wet conditions, appears in Sun Oil Co.'s technical bulletin No. 17.

Ten viscosity grades of low cost Solnus oils are now described in detail. According to Sun Oil, they are recommended for both once-through and continuous-use application on plain and antifriction bearings, linkages, cams, gears and gear boxes, compressors, cylinders and crankcases, hydraulic systems, and low speed diesel engines. **(94)**

SIZES, specifications, finishes, tolerances, chemistry and suitable applications of small dia tubing (up to 1-in. O.D.) is presented in a new 20-page bulletin (No. 13) by J. Bishop & Co. Platinum Works.

Bishop manufactures all types of platinum products and chemicals and redrawers of small dia stainless steel, nickel, and nickel alloys. **(95)**

MOTORIZED hydraulic power packages featuring a unique, highly efficient design are described in Bulletin 61-82, available from Vickers Inc., Div. of Sperry Rand Corp. The packages, containing pump, electric motor, valving and reservoir in one compact unit, can be used in practically any hydraulic application. **(96)**

E&MJ Monitor

ALLIS-CHALMERS vibrating mill, which can efficiently process a wide range of materials and is 15 to 30 times more productive than conventional mills of the same size is described in Bulletin 07B1028.

Suitable for wet or dry grinding, open or closed circuit, the mill can be operated with steel or non-metallic grinding media and liners. It is adaptable to grinding in inert atmosphere and is available in 15-, 30-, 36- and 42-in. dia chambers. **(98)**

HOW TO apply tungsten carbide hard facing is described in a new eight-page illustrated bulletin (No. B-175A) from Kennametal Inc.

Four forms of Kennametal hard surfacing materials are covered: Tube Kenface, applied by three methods; Kenface bulk powder, suitable for many methods of application; Kenspray powder, applied by metal spray gun and then fused at 1875 to 1950°F; and a new Kenface Arc Rod KT-200, developed to improve application of hard surfaces by ac or dc electric arc. **(99)**

DESIGN and operation of the new D-O 2700 DSM screen, especially adapted for operation in grinding of cement raw mix, is described by Dorr-Oliver in a new leaflet (No. 2300-A). **(100)**

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Circle the numbers of items in which you are interested. Then place this form in an envelope and mail to:

New Products
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with Primacord M/S Connectors for accurate dependable millisecond surface-delay blasting

You can enjoy the advantages of delay blasting without the hazards of sensitive delays in the holes. In open pit mines, quarries and construction blasting – medium to large diameter holes – use the Primacord System of initiation with Primacord M/S Connectors tied into the Primacord trunklines.

An infinite number of delay firing patterns is possible. And the size or length of a blast is limited only by the blast area.

The Primacord M/S Connector* is available through all explosives manufacturers. It is an economical and dependable non-electric delay device that is insensitive to static or stray electric currents. Made to provide delay periods of 5, 9 or 17 milliseconds, several Connectors may be used in series when longer delays are required.

Primacord Detonating Fuse has proved its outstanding advantages over many years of use:

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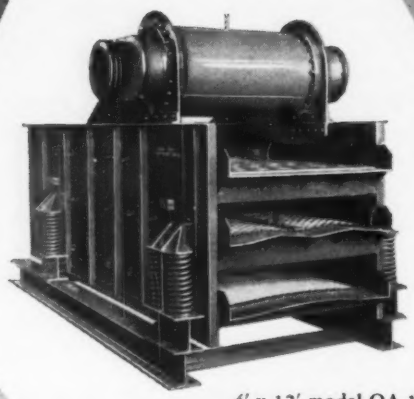
Free! NEW GUIDE AND CONDENSED MANUAL: "PRIMACORD DETONATING FUSE . . . WHAT IT IS . . . HOW TO USE IT." ASK YOUR EXPLOSIVES MANUFACTURER OR WRITE US GIVING YOUR COMPANY NAME.

NUMBER ④ IN A SERIES OF FOUR

BIG CHIEF mine dewaters 2500 tons per day with SIMPLICITY horizontal and gyrating screens

Fast, dependable SIMPLICITY machines maintain a two-shift production of 2500 tons of graded coal in the Big Chief Mine at Seco, Kentucky. The South East Coal Company employs 2 Os-A-Veyor Feeders . . . 1 Os-A-Veyor Picking Table . . . 4 Simplicity De-watering screens, (3 horizontal, 1 gyrating) . . . 5 Double-Deck Gyrating Screens and 4 Single-Deck Gyrating Screens. Installed in 1951, these SIMPLICITY machines continue to give maximum service with low maintenance cost.

Water and coal are pumped to two Simplicity 4' x 12' triple deck Horizontal Dewatering Screens. Water is removed and the coal graded into 3 sizes. The small size is fed off the third deck to a secondary 4' x 12' Horizontal Dewatering Screen. Water and fines screened from stoker coal go to a concrete settling tank and from there to a Gyrating Sludge Dewatering Screen.



4' x 12' model OA-10-MA 3 deck flat screen for dewatering coal.

The demand for cleaner coal in smaller sizes has led to the need for dewatering coal after washing. SIMPLICITY Horizontal Screens, with their heavy-duty assemblies and larger screening areas, have proven extremely successful in this operation.

SALES REPRESENTATIVES IN ALL PARTS OF THE U.S.A.

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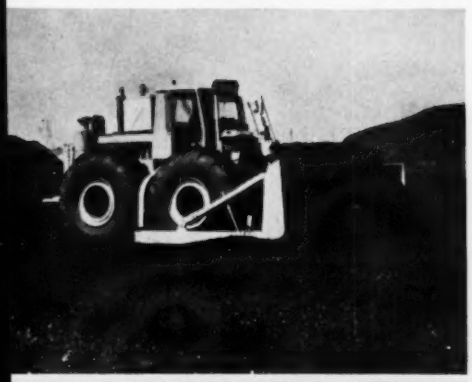
210

ENGINEERING COMPANY • DURAND 4, MICHIGAN

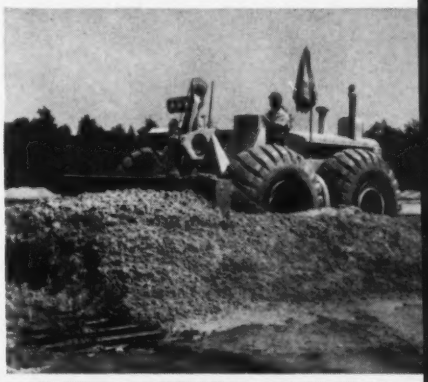
THIS rubber-tired tractor will cut costs FOR YOU

Because Tournatractor® works so fast and drives anywhere, you get your work done with fewer machines, fewer men. Illustrated here are some of the ways this 218-hp LeTourneau-Westinghouse tractor can save money *for you:*

Clean-up pit floor — One mobile Tournatractor often does the work of 2 or more crawler tractors, easily serves several shovels in scattered pit areas. Travels fast, works fast. You get quick acceleration with 218-hp operating through a sealed anti-friction drive. There's no loss of momentum to shift gears, because LW tractor's gears are constantly in mesh.



Build and dress stockpiles — LW tractor spreads coal and other materials quickly . . . and *at the same time* its big 2-ft wide, low-pressure tires give you maximum compaction without crushing. 15-ft wide LW C-blade (shown) gives you bigger, full-capacity loads with little or no spillage . . . cuts stockpiling time *in half!*



Feed hoppers — Fast forward and reverse speeds let you move more tons per hour. And with enclosed anti-friction drive and fewer moving parts, LW tractor is better protected from grit and wear . . . gives you higher efficiency through *more* hours of continuous service.

Handles miscellaneous tractor jobs — At a moment's notice, mobile Tournatractor is on its way to handle your dump clean-up, road-and-plant maintenance, towing service, or any other emergency tractor jobs that crop up. Tractor's big tires travel unplanked pavement, cross RR tracks, ties, etc., without damage.

Switch railcars — For spotting RR cars at sidings, railheads, etc., your Tournatractor may be equipped with a standard type E railway coupler on the rear. Rolling on big rubber tires, this off-track "switcher" maneuvers quickly and short-cuts travel from spur-to-spur.

See it in action

Let us show you how 218-hp LW Tournatractor can fit into your operations to save money for you. Available with electric or hydraulic blade control, speeds to 18.5 mph. Ask for details and demonstration. CT-2449-MQ-1

LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

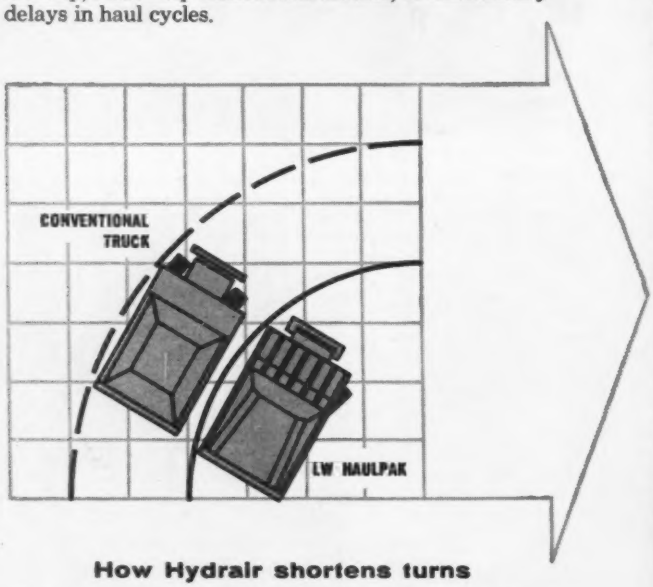
LW HAULPAK®

turns short..

The time-saving maneuverability you get from Haulpak's power-steer system, from Hydrair® suspension, and from its short wheelbase can add extra trips to your daily production. LeTourneau-Westinghouse Haulpak trucks make continuous 180° turns in confined quarters where other trucks have to jockey back-and-forth two and three times.

⅓ shorter turn circle

Haulpak turns in ⅓ *less* space than comparable haulers, and much shorter than many smaller rigs. This exceptional maneuverability lets you spot, swing around, back up, and dump without lost motion, or unnecessary delays in haul cycles.



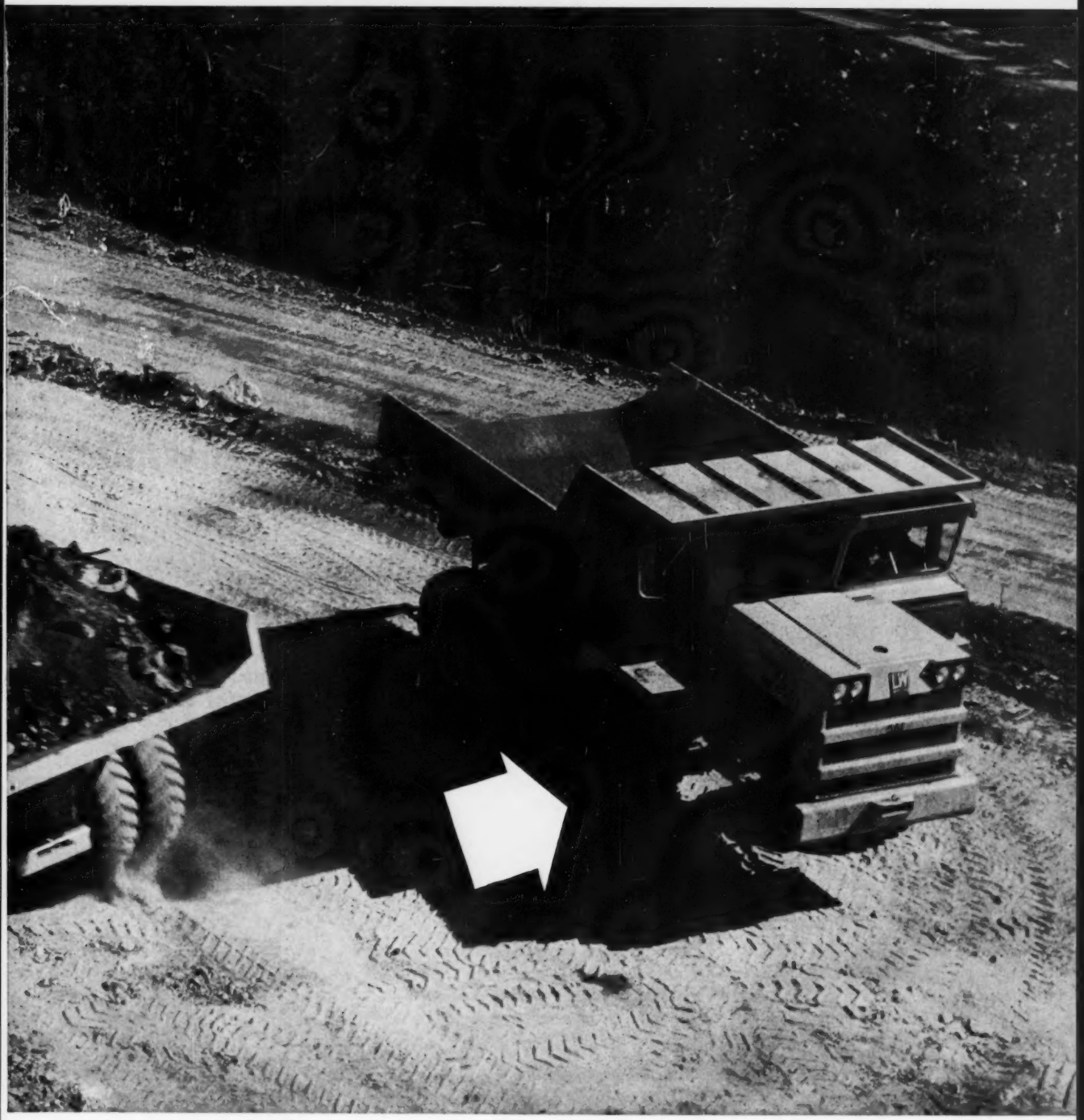
How Hydrair shortens turns

With exclusive LW Hydrair suspension, conventional front-axle and springs are eliminated. There's no interference with steering wheels. You get a sharp 45° front-wheel turn in each direction. In addition, the elimination of big, long springs, front and rear, shortens Haulpak wheelbase . . . further reducing turn radius. There is, however, no sacrifice in load capacity because of LW's deep V-body design.

There are many other ways Haulpak saves time and money. Your LeTourneau-Westinghouse Distributor will be happy to tell you about them, and will arrange to show you these off-road trucks in action. 5 end-dump sizes, 22 to 65 tons . . . up to 550 hp. 90-ton bottom-dump also available.

HP-2467-G-2

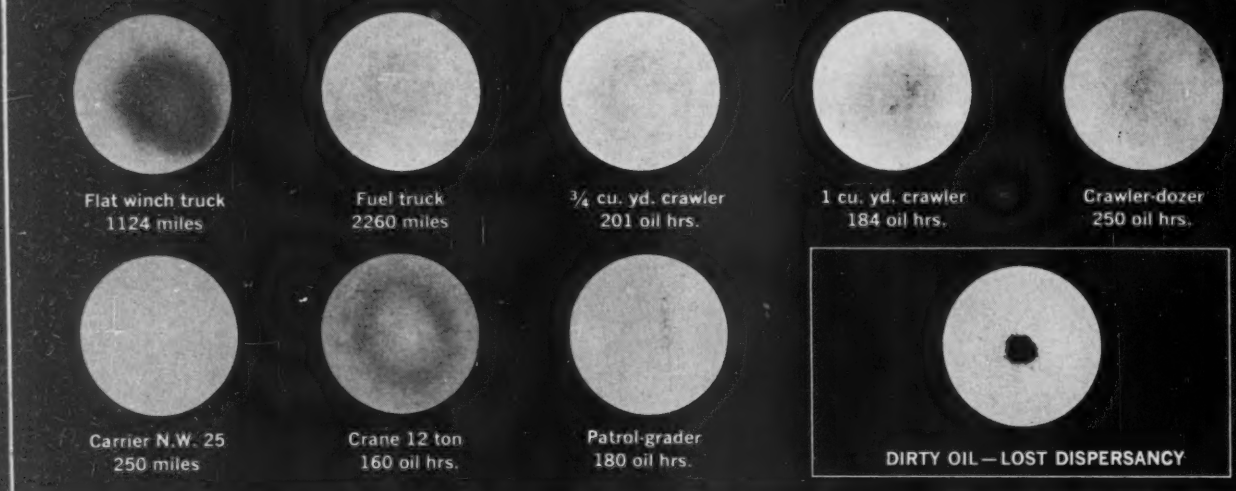
. . spots fast



LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



The Oilprints above were taken from nine different engines. The first eight oil samples are from engines using Shell Rotella T Oil 20W/40. Compare their cleanliness with the sample in the box. The oil sample in the box is heavily contaminated, a potential source of trouble.

EVIDENCE:

"These Oilprints show how Shell Rotella T Oil 20W/40 helped us solve a major overhaul problem in a climate that ranges from sub-zero to sizzling hot."

—says successful Michigan excavation contractor.

A Michigan contractor* switched his entire fleet to Rotella® T Oil 20W/40—80 vehicles, 8 different types of equipment.

He now reports longer engine life due to reduced piston ring wear, reduced valve train problems and easier starting.

Read about his experience with Rotella T Oil 20W/40 and the Shell ADC® Oilprint Analysis.

"STICKING valves were causing premature engine failure," reports this contractor. "Then we tried Shell's Rotella T Oil 20W/40.

"Since then, valve train failures have been drastically reduced. Engines last longer.

"Starting is no problem now, even when the weather is well below freezing.

"Our entire fleet is now on Shell Rotella T Oil 20W/40. Cranes, bulldozers, pickups, cars—everything.

"Periodic checks with Shell's ADC® Oilprint Analysis show that we get improved oil performance with this Shell oil. And the Oilprints help us spot many troubles before they can become serious.

"For example, an internal coolant leak often will show up on an Oilprint before there are any other symptoms. What's even more important, Shell ADC Oilprints have helped establish the proper oil drain schedule for each engine."

Four key ways that Shell Rotella T 20W/40 can help cut costs

1 It can increase fuel mileage by reducing engine friction in cold weather.
2 It reduces motor oil inventory to a single, multi-purpose, all-season oil.
3 It can help reduce engine wear rates and extend overhaul intervals.
4 It lengthens battery life because engines start easier on cold mornings.

See your Shell Representative for full details about Rotella T Oil 20W/40 and the Shell ADC Oilprint Analysis. And ask him about Shell Rimula® Oil. It's recommended for all equipment requiring Series 3 oil.

SHELL

A Bulletin from Shell
—where 1997 scientists are working to provide better products for industry

*Name on request

JOY HAS THE RIGHT SLUSHER FOR THE JOB

Model No.	Horsepower
S-211	5 hp
FF-211 & FF-311	7½, 10, 15 hp
A2F-211 & A2F-311	15, 20, 25 hp
B2F-211 & B2F-311	20, 25, 30, 40 hp
C2F-211A & C2F-311A	50, 60, 75 hp
R-221 & R-222	100, 125 hp
RF-211-212	100, 125 hp
XT-221 & XT-222	150 hp

With a complete line of job-rated slushers, Joy can recommend the proper unit to do the job efficiently. For true economy on the small jobs, Joy offers the S-211 and FF-211 line in sizes from 5 to 15 horsepower. These units are air or electric driven and extremely compact for portability underground.

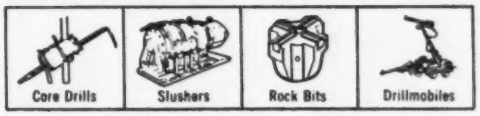
For medium capacity, Joy builds A and B class slushers from 15 to 40 hp. These two and three drum slushers are designed to handle the bulk of scraping jobs.

Three larger units in the "C" series go up to 75 hp for the heavy-duty jobs where portability is still required. For the largest semi-permanent installations, Joy builds large capacity slushers from 100 to 150 horsepower.

With more than 300 types and sizes of hoists and slushers to choose from, there is not a scraping job that can't be handled most efficiently with a Joy unit. Call in a Joy engineer for the size and type to suit your scraping jobs or write for bulletin 950-4.

EQUIPMENT FOR MINING...FOR ALL INDUSTRY

JOY



Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

CHROMEX B
H-W MAGNESITE
Here
are two
fine-performing
basic refractories
for
copper
converters

CHROMEX B is an extra hard-burned chrome-magnesite brick with high density and low permeability . . . good resistance to thermal shock . . . unusual stability and high strength at high temperatures.

H-W MAGNESITE is a superior hard-burned refractory, consisting predominately of periclase (stabilized crystalline magnesia), for the most severe requirements of copper converters. It is dense, strong and volume stable at temperatures far above the highest employed in copper converters.

These quality-controlled Harbison-Walker basic refractories are used also with great benefit in longer life for parts of copper reverberatory smelting and refining furnaces.

INCREASED PRODUCTION... EXTENDED SERVICE LIFE... REDUCED OPERATING COSTS

Contact Harbison-Walker Technical Service Department for complete application details.

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only one moving part makes dependable percussion drilling power

The piston is the only moving part, which means less wear and less trouble. No complicated valving to sand up as in many bottom hole pneumatic impact tools. You can easily change the choke which adjusts the Hammerdril to the air volume needed from your 100 psi compressor. The Series 100 Hammerdril® is an air miser, too. All the air goes through the Hammerbit® to clean or to drill. None is wasted. This splined, one piece Hammerbit has heavy tungsten-carbide inserts for long life. Service is available in your area. Write for new bulletin.

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HAMMERDRIL

P. O. BOX 4209 · HOUSTON, TEXAS / OVER THIRTY YEARS OF DRILLING RESEARCH

the cry goes out,

"Reach me the Milker"

AND FLYGT PUMPS GO TO WORK AT OGLEBAY-NORTON COMPANY COAL MINE

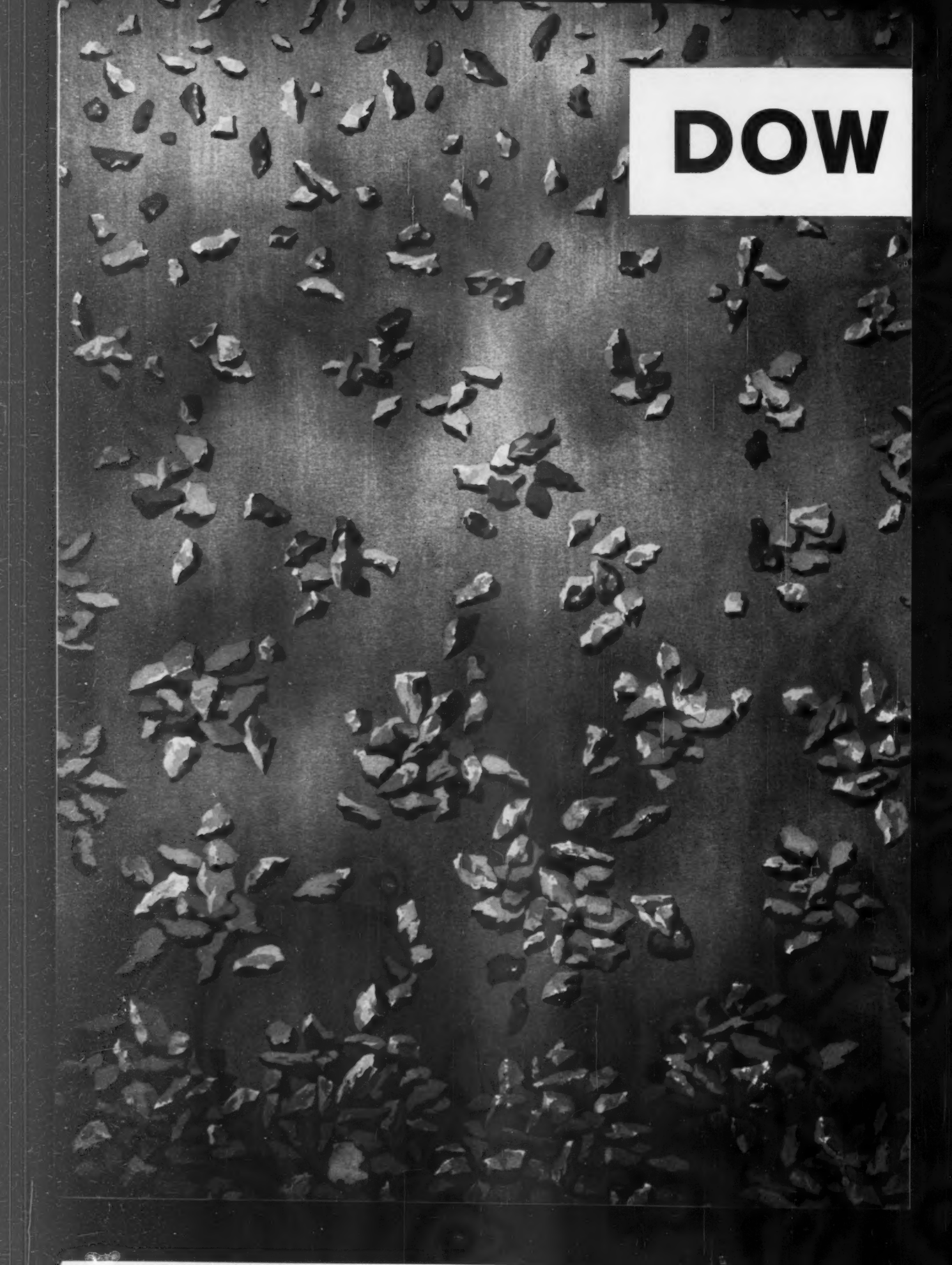
Racked up along Brule No. 3's main haul, five Flygt Model B-38L electric submersible pumps await the familiar call for the "Milker," a nickname given them by the mine crews. At the first sign of water accumulation along one of the solid coal walls, a Flygt is moved into place and left on its own to completely dewater the area — right down to dampness. Oglebay-Norton officials say, "We like these pumps. They are the best we have ever used. We turn them on and they do the job." Dependability, high capacity and a mere 77 lbs. to carry provide the answer to Flygt's success at this Otsego, W. Va. mine. I. R. Lambert, mine foreman said, "We had to have something that would work without a lot of fixing. Our Flygts fill the bill." No matter what your dewatering problem might be, Flygt has a pump in their 7 model line to lick it.

PUMP BETTER ELECTRICALLY — USE FLYGT!

ORIGINAL MANUFACTURERS OF ELECTRIC SUBMERSIBLE 'DIRTY WATER' PUMPS!

FLY Corporation HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif. -IN CANADA- FLYGT CANADA LIMITED, Montreal, P. Q.


DOW

mining chemicals

SEPARAN

SEPARAN IMPROVES SETTLING RATES UP TO 2600% IN ACID OR ALKALINE PULPS

Separan® flocculants can be relied upon to make drastic reductions in settling time on nearly every kind of suspended solid over the entire pH range. For example, it will flocculate solids effectively in 60% sulfuric acid, in leach solutions of pH 1, in neutral solutions, in hot 10% soda ash solutions, and in hot 4% caustic soda solutions.

Many milling operations have cut operating costs by using Separan to increase settling time, improve overhead clarity, and speed the filtration rate.

Separan flocculants are water-soluble polymers of acrylamide, which function most effectively at minimum dosages. And unlike some polyelectrolytes excessive amounts do *not* cause redispersion of the solids. Although no two ores are exactly alike, Separan has improved settling or filtration rates of copper, lead, zinc concentrates, and tailings. It has also proved effective in the production of potash, taconite, uranium, tungsten, manganese, barytes, coal, borax, soda ash, and ammonia-leached nickel. Complete technology is available from Dow.

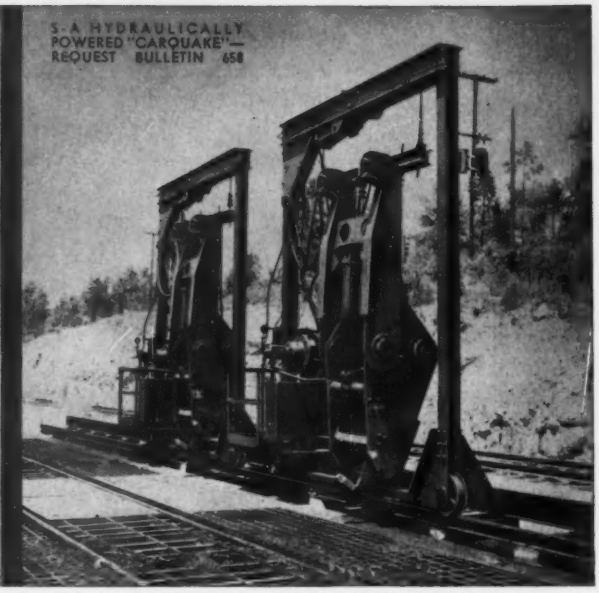
IMPROVED SETTLING RATES WITH SEPARAN
(clear overflow)

	Lbs. Separan per ton of solids	Settling rate (inches/minute)		Percent improvement
		untreated	treated	
COPPER CONCENTRATES	.05	.11	.49	340%
ZINC CONCENTRATES	.03	1.82	8.0	340%
URANIUM SLIMES	.01	1.25	12.5	900%
URANIUM ORE	.10	.068	1.93	2600%

For all your mineral processing problems involving chemicals, you may obtain expert assistance from the Dow Mining Technical Service Department. To obtain technical service or our new digest, *Chemicals for the Mining Industry*, write to THE DOW CHEMICAL COMPANY, Abbott Road Buildings, Midland, Mich., Attn: Chemicals Merchandising, Dept. 750BD10.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

STEPHENS-ADAMSON



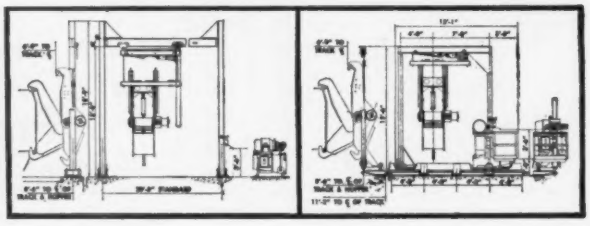
SPEEDS THE SPOTTING AND UNLOADING OF RAILROAD CARS

CONTINUOUS CAR PULLERS

S-A Continuous Type Wire Rope Car Pullers are cutting costs at many plants by speeding up loading and unloading of all types of railroad cars. Designed for installations requiring long hauls, cars can be moved in either direction on straight or curved tracks. Since each installation requires careful consideration, we suggest you let S-A Engineering Know-How help solve your specific problem.

HYDRAULICALLY POWERED "CARQUAKE"

One man easily unloads hopper-bottom railroad cars quickly, efficiently and with less noise than overhead car shakeouts. Hydraulically powered vibration utilizes controlled speed to match required capacity. The S-A "CARQUAKE" requires no expensive overhead structures . . . a completely self contained unit—unlimited movement parallel to track. The installation of an S-A "CARQUAKE" avoids demurrage charges —saves manpower—speeds unloading operations.

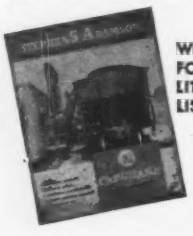


MODEL 963 DRUM TYPE WIRE ROPE CAR PULLER
Available in three sizes for heavy duty pulling and hoisting for rope pulls from 9,000 to 22,500 pounds. The pulling rope is deadended to drum, which holds enough rope to pull loads over distances of 250 to 500 feet. Where cars must be pulled and lowered on inclines, motor can be reversible.

MODEL 967 DRUM TYPE WIRE ROPE CAR PULLERS
Available in six sizes with rope pulling capacities up to 15,000 pounds. Pulling rope is deadended to drum, which holds enough rope to pull loads over distances of 390 to 727 feet. Where cars must be pulled and lowered on inclines, drive motor can be reversible.

TYPE "B" STATIONARY MOUNTED CARQUAKE
Designed for applications where only slight movement parallel to hopper cars and tracks is required. The unit is mounted to the customer's concrete hopper foundation or steel structure with anchor bolts.

TYPE "C" RAIL MOUNTED CARQUAKE
Mounted on rails permitting travel any desired distance and unloading into any hopper. Concrete piers or steel structure for anchoring rails are all customer need furnish.



WRITE FOR LITERATURE LISTED

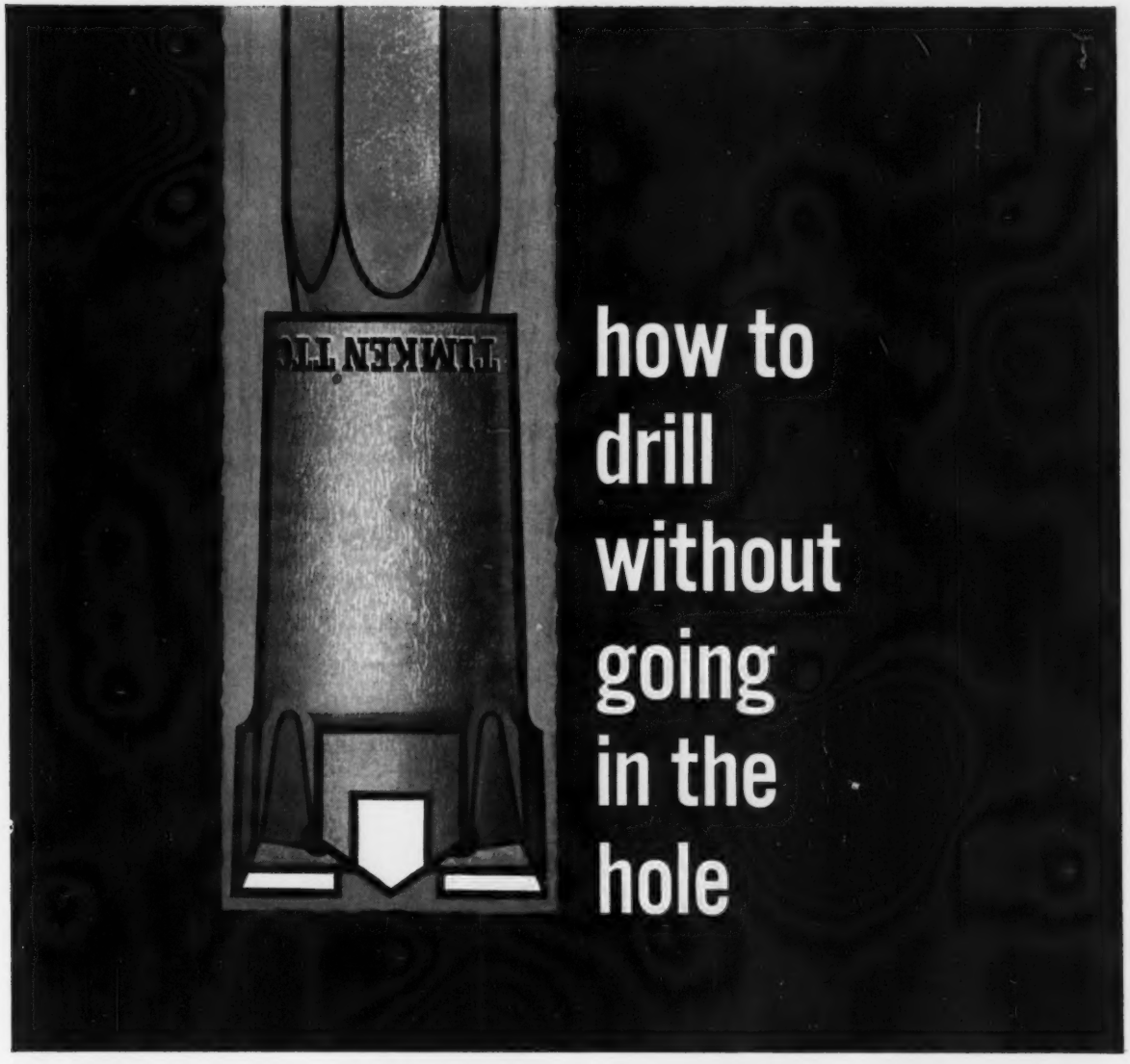
S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIAL HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SPHERICO® BEARINGS & ROD ENDS

ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 4 RIDGEWAY AVE., AURORA, ILL.

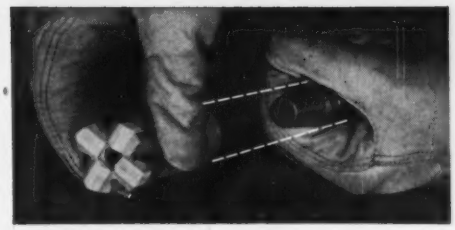
PLANTS LOCATED IN: LOS ANGELES, CALIF. • CLARKSDALE, MISS. BELLEVILLE, ONT. • MEXICO CITY, D. F.



It's getting tougher to make a profit drilling rock. Now, you can get more hole-per-bit at less cost by using the improved Timken® tapered socket carbide insert bit. It cuts air-leg drilling costs because: 1) *New brazing process* bonds the carbides firmly to the bit body to increase shock-resistance. Inserts and bits last longer. 2) *Improved heat treating* process produces bit bodies of more uniform hardness and structure. The resulting greater strength practically eliminates ring-off and breakage.

And drilling goes faster because the bit's 5 front hole design, pioneered by the Timken Company, shoots air or water forward to speed chip removal. Deeper, wider wing clearance lets chips wash back faster. You can save on gauge wear, too. Timken removable bits give longer bit life because they have four cutting edges. Most intrasets have only two.

For complete information about the cost-cutting TTC bit, send for free brochure, "Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.



Removable yet one-piece strong!

The consistently uniform tapered socket assures a secure union between bit and drill steel, yet detaches easily, reduces breakage. You get the advantages of removability *plus* one-piece strength in Timken bits.

TIMKEN®

removable rock bits

PROGRESS REPORT: ATLANTIC CITY PROJECT

Dings Magnetic Separators to serve Multi-million dollar Wyoming Taconite Project for Columbia-Geneva

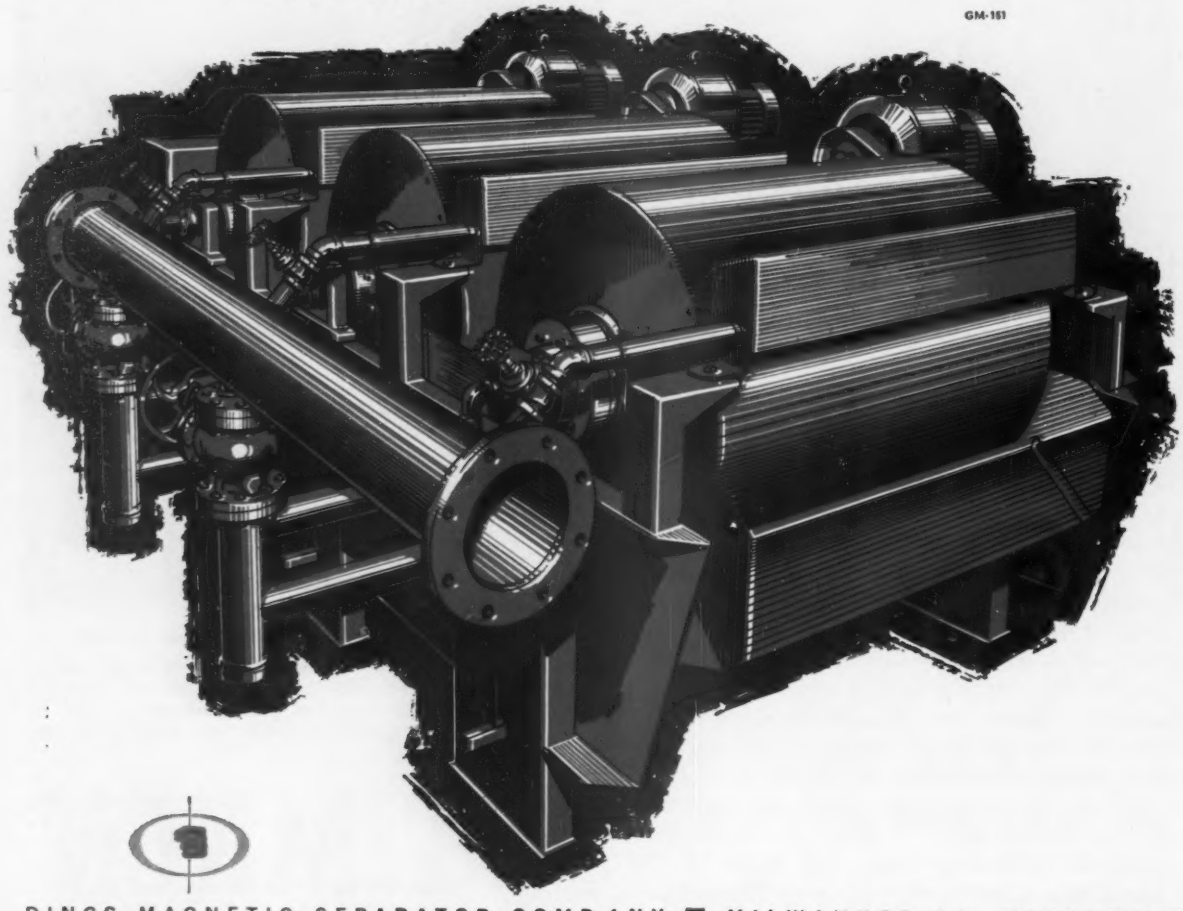
108 Dings Electromagnetic Drums of an improved design will serve the important magnetic separation processes for Columbia-Geneva's new high-grade taconite beneficiation facility.

Cooperation—between Dings and Columbia-Geneva technical personnel in working out specific equipment requirements to best serve this operation—has resulted in magnetic separation equipment designed to provide high recovery efficiencies . . . with a minimum of operational attention.

Here, as elsewhere, Dings' long history of experience in the field of magnetic separation has been put to work to help further improve the economic future of low-grade iron ore processing.

The Atlantic City Project will utilize 108 Dings Electromagnetic Drums for the cobbing, roughing operations and finished recovery of the taconite ore. Designed for continuous service, these advanced type separators will utilize expendable liners at wear points for ease of maintenance. Electro-type drums permit varying of the intensity of the magnetic field for desired metallurgy.

GM-151



DINGS MAGNETIC SEPARATOR COMPANY ■ MILWAUKEE 46, WISCONSIN

BUCYRUS-ERIE OFFERS

A COMPLETE LINE OF QUARRY AND MINE EXCAVATORS IN CAPACITIES FROM 4 ½ to 18 CU. YDS.

A MODEL TO FIT EVERY REQUIREMENT

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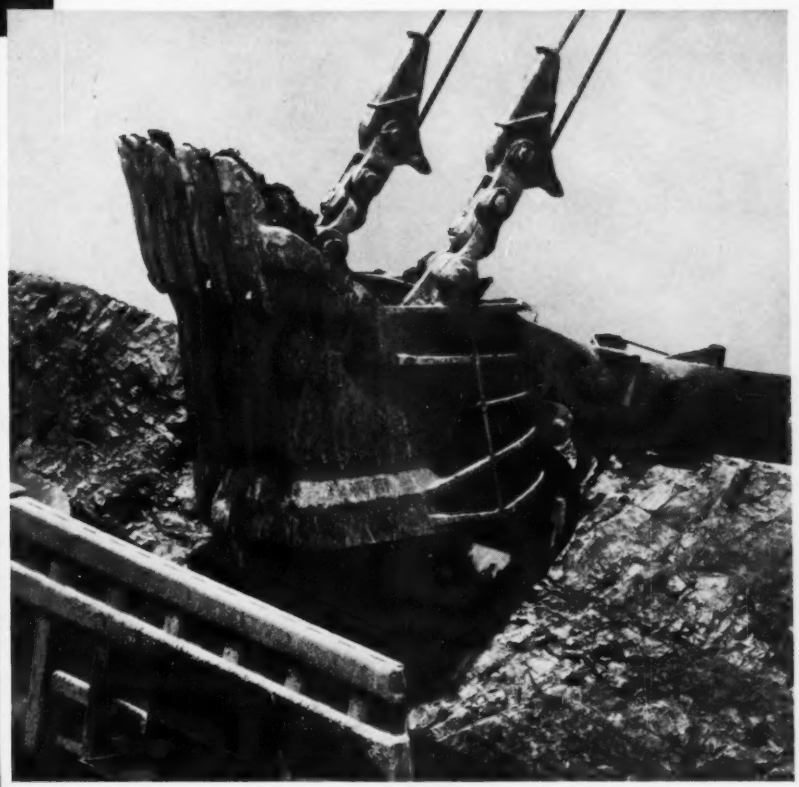
- 150-B
- 210-B
- 190-B
- 250-B
- 270-B



BUCYRUS-ERIE COMPANY

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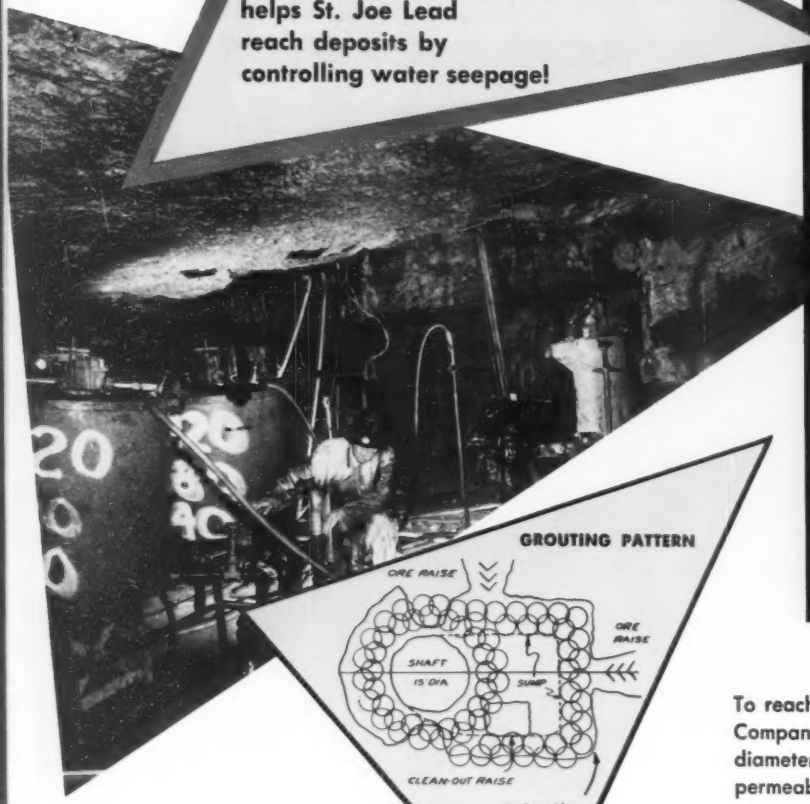
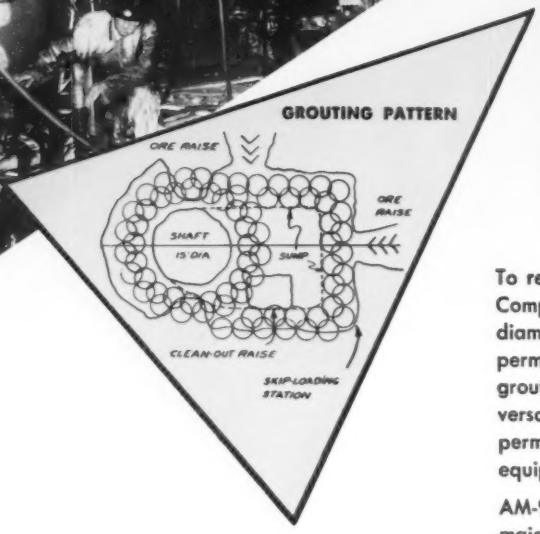
BUCYRUS ERIE

Representatives and service throughout the U.S.A.
Distributors in all other principal countries of the world

how CYANAMID products help get the lead out!

AM-9*
CHEMICAL GROUT
helps St. Joe Lead reach deposits by controlling water seepage!





To reach newly discovered lead deposits, St. Joseph Lead Company was faced with the job of sinking large diameter, deep shafts through high pressure, highly permeable, water-bearing Lamotte sandstone. Various grouting methods were investigated. Cyanamid's versatile new chemical grout, AM-9, was selected because it permeated the sandstone, was easy to handle with available equipment and gel time could be closely controlled.

AM-9 has been successfully used by St. Joe Lead in three major shaft sinking operations. In sinking the Viburnum No. 28 shaft, for example, shaft had to bottom in water-bearing sandstone, a drift sump had to be cut and a short spillrock raise driven to the loading pocket. Flow from initial test hole was 60 gpm and static formation pressure was 260 psi. In order to form an impermeable grout curtain around the area, 43,500 gallons of 7.5% AM-9 solution was pumped into a double fence of grout holes, 88' deep. Outer holes were spaced 4' apart, 13' from shaft center. Inner holes were collared 11' from the center and spaced between outer holes. Grouting pressure occasionally reached 1,100 psi but averaged around 400 psi.

AM-9 Chemical Grout quickly sealed the smallest openings and effectively reduced water flow. Grouting was completed in 24 days with significant savings in time and labor.

Please send additional information on

- ☐ AM-9 Chemical Grout
- ☐ Cyanamid Reagents

Name _____

Company _____ **Title** _____

Address _____

_____

CYANAMID REAGENTS

Help St. Joe Lead Improve Metallurgy by Reducing Cost-Plus-Tails!

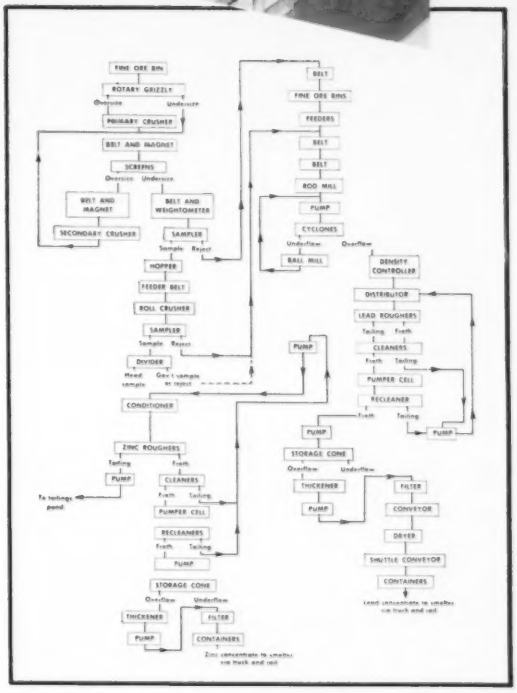
St. Joe Lead's new Viburnum project, representing the best in mining and milling that St. Joe has developed through years of experience, includes in its operation Cyanamid reagents for maximum recovery at lowest reagent cost.

Current 3,000-ton flotation plant is handling production from No. 27 and 28 mines. Ultimate mill capacity will be 6,000 tpd. Ore, consisting chiefly of galena disseminated in dolomite with minor quantities of zinc and copper sulfides, runs about 3 to 3.5% Pb. Flotation rougher feed is ground to 57% minus 200 mesh. Lead concentrates assay about 73% lead, tailings average 0.07% lead, with a recovery of over 97%. Provision for recovery of zinc and copper has been designed into the mill.

Reagent combination for initial operation includes 0.09 lb/ton AEROFLOAT® 31 Promoter and 0.03 lb/ton AEROFROTH® 77 Frother. Reagent consumption is low because of absence of pyrite. No lime or depressants are required.

Cyanamid offers the mining industry a single source for a complete range of metallurgical chemicals. In addition, experienced Field Representatives provide valuable in-the-mill assistance in their use and our Stamford, Connecticut Laboratories provide a continuous flow of up-to-date beneficiation data.

For complete information on our products and services, contact our nearest office.



CYANAMID

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

BOUND BROOK, NEW JERSEY

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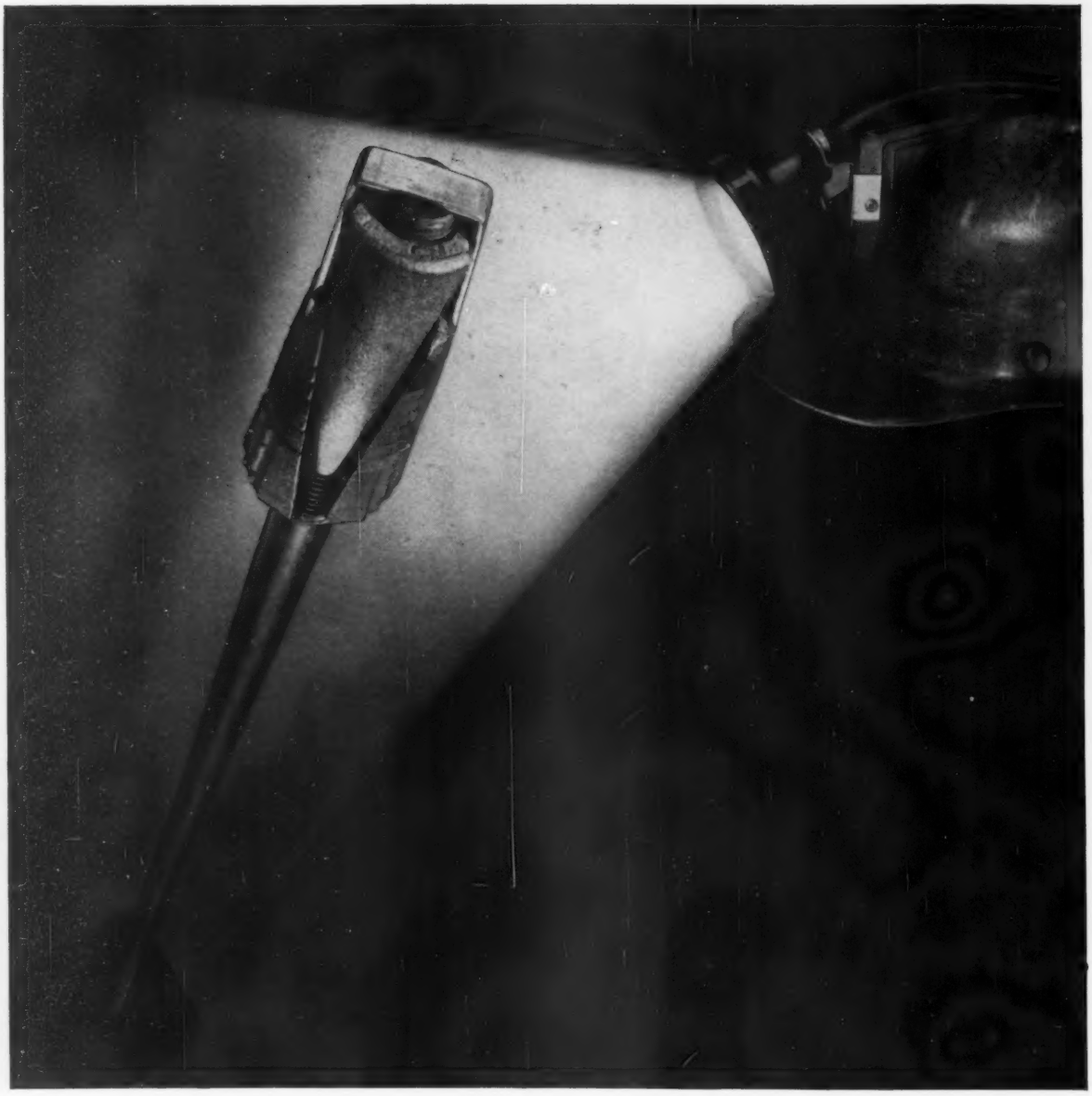

Looking for a way to save money safely?

Then look at CF&I Rock Bolts with the Pattin Shell — the truly modern form of roof, wall and back support to reduce both costs and accidents.

Mine records have shown that CF&I Rock Bolts with lagging of Realock Metallic Fabric mean savings of up to 35% over conventional timbering.

And CF&I Rock Bolts provide greater safety because the double expansion shell makes continuous contact along the entire length of the shell. This means that in any type of rock you get maximum anchorage and resistance to load with minimum displacement of the shell.

Put these two factors together and you've got a combination that's hard to beat. Your nearby CF&I sales office will be glad to give you complete details on Rock Bolts—either Expansion Type with Pattin Shell or Slot and Wedge Type—and other CF&I Mining Products. Call today.

The Colorado Fuel and Iron Corporation
Denver • Oakland • New York
Sales offices in Key Cities

Other quality CF&I Steel Products for basic industries
Grinding Balls • Grinding Rods • Mine Rails and Accessories
Realock Metallic Fabric • Industrial Screens • Wickwire Rope • Grader Blades

Steel

For a variety of durable industrial products

NEW PLASTIC SHELL CASE

Now standard on all Republic Bail-Type Roof Bolts

Already a preferred product among leading mine operators, Republic Mine Roof Bolts now offer another new, advanced feature—polyethylene shell cases for bail-type bolts. Standard on all Republic Bail-Type Roof Bolts at no extra cost.

PROTECTS SHELLS IN STORAGE—SIMPLIFIES HANDLING AND INSTALLATION. The new shell case is unaffected by moisture and corrosive conditions often present in mine storage areas—protects against shell damage and lost parts. The plastic case can be left on the shell when installed, makes installation faster and easier.

RED SHELL CASE—MARK OF QUALITY. Republic Bail-Type Roof Bolts can be identified at a glance. The bright red shell case, a Republic exclusive, tells you that it's a Certified Quality Republic Bolt. Steel chemistry, yield point and break point are known quantities for predictable, top performance at lowest cost.

To meet specific conditions in your mines, Republic offers the largest selection of roof bolts available anywhere. Field trained Republic Mine Roof Bolt Engineers are available to work with you in selecting the best bolt for your requirements. Send the coupon for more information on Republic Roof Bolts and obligation-free field service.

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Please send further information on:

☐ Republic Roof Bolts ☐ Republic Roof Bolt Field Service

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Company _____

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FLO-GEL and FLO-GEL HD

NEW EXPLOSIVES FOR QUARRY AND OPEN-PIT BLASTING

Flo-gel (pronounced FLOW-GEL) and Flo-gel HD are non-nitroglycerin gelatin type explosives that provide high loading densities where concentrated loads are needed.

Some of the advantages of using Flo-gel and Flo-gel HD are:

1 More energy per foot of bore hole with higher loading densities.

2 Increased energy (as much as 20%) may permit greater spacings and burden.

3 Improved fragmentation because of high rate of detonation coupled with increased energy.

4 Wet holes may be preloaded.

FLO-GEL AND FLO-GEL HD
contain no nitroglycerin • are nonheadache producing • are insensitive to blasting caps • will not detonate from rifle bullet impact • will not propagate from hole to hole • will not drain off in rock fractures • provide high loading densities • possess excellent water resistance

Ask your Hercules representative for details on how Flo-gel and Flo-gel HD can save you money in your blasting operations.

HERCULES POWDER COMPANY

Explosives Department, Hercules Tower, 910 Market Street, Wilmington 99, Delaware XR61-4

*Hercules Trade Mark

BIRMINGHAM • CHICAGO • DULUTH • JOPLIN • LOS ANGELES • NEW YORK • PITTSBURGH • SALT LAKE CITY • SAN FRANCISCO

The BELT Lasts Longer!

(and so do maintenance dollars!)

. . .with McNally Pittsburg's new conveyor

Here is a new and entirely different type of belt conveyor. The secret of its amazingly improved efficiency is in the exclusive design of the McNally Pittsburg patented cradle idler, which consists of 5" rubber rollers, assembled on precision-ground ball bearings, prelubricated and lifetime sealed. The rollers are suspended in a true catenary, on flexible, nonrotating stainless steel wire rope, which cannot corrode. Because the wire rope does not rotate, it cannot twist and cause loping, dangerous harmonics, and undue belt wear.

The wire rope is supported at each end by a simple ball joint, so it is free to move in any direction, permitting the belt to adjust itself to any profile. The true catenary suspension provides uniform belt support without bends or creases. *Thus belt life is substantially increased.* The entire conveyor is shipped disassembled, and may be put together in the field to fit your application.

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☐ Please send information on the new McNally Pittsburg Belt Conveyor.

☐ Have Sales Engineer call for further consultation.

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Better Balanced Euclid C-6 gets more work done!

Owners of the "Euc" C-6 report that it's the best balanced tractor in the 200 h.p. class. Low center of gravity and close mounting of blades made possible by a rear-mounted radiator eliminate "nosing down" in heavy dozing work. The C-6 works easily on slopes where other crawlers can't be used because they won't hold on . . . and lower ground pressures let the "Euc" work in soft going that stops competitive tractors.

You've really got to see a C-6 at work to know what its excellent balance means in performance and productive capacity . . . your Euclid dealer will make arrangements, so get in touch with him soon.

C-6 *. . . lowest cost crawler in the 200 h.p. class . . . and most versatile by far!*

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EUCLID

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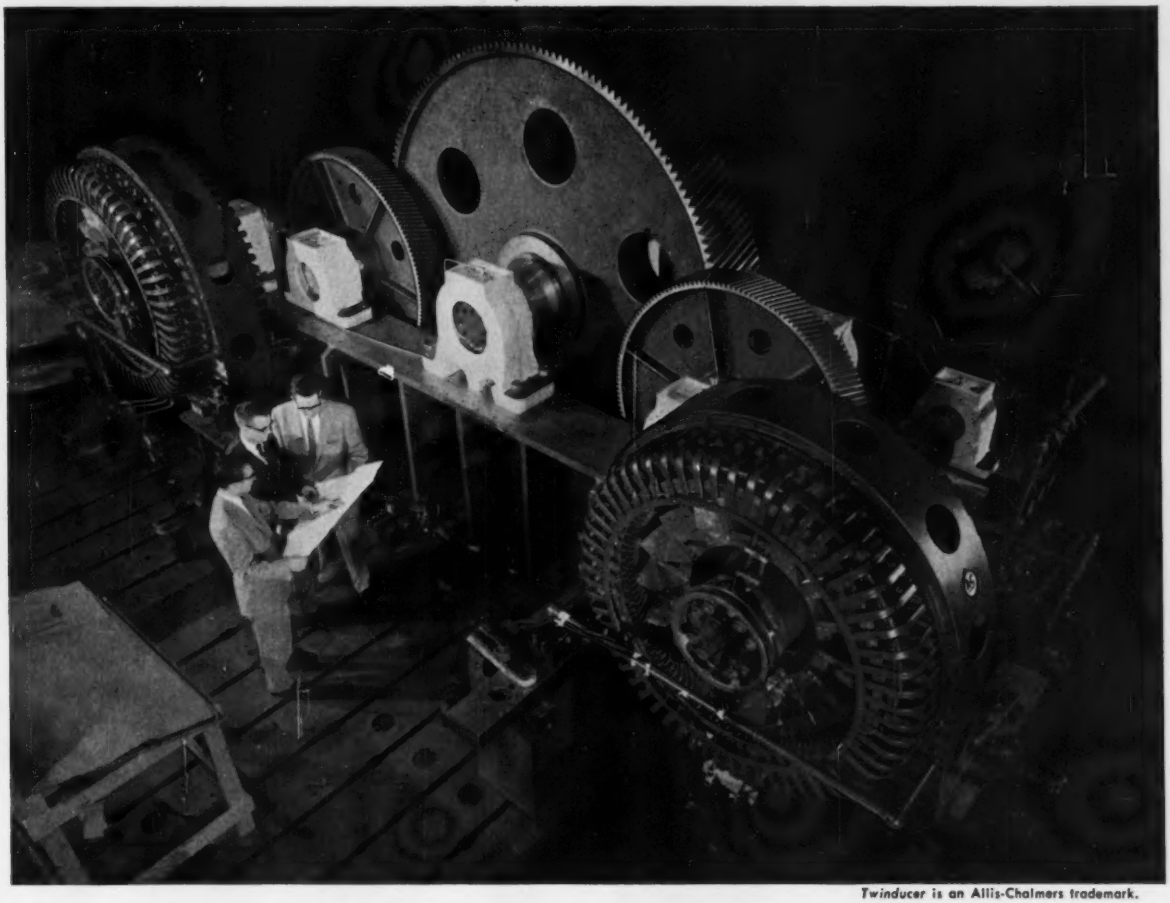
Plants at Cleveland and Hudson, Ohio and Lanarkshire, Scotland

ALLIS-CHALMERS



Twinducer is an Allis-Chalmers trademark.

Full-load demonstration proves 98%-plus efficiency of Twinducer grinding mill drive

New, twin-motor drive system divides mill load electrically, saves space and installation costs, extends gear-train life.

To show the high efficiency of the *Twinducer* drive, Allis-Chalmers engineers recently conducted a series of full-load demonstrations at the factory.

Full load was simulated by coupling two *Twinducer* drives. Driver unit was coupled to driven unit. Load on driven unit was two equally loaded generators.

Power input to the motors was measured, and compared with the output of the generators. Efficiencies (exclusive of ordinary motor and generator power losses) were found to range from 98.48% to 98.52% . . . more than twice the efficiency of most conventional mill drives.

The *Twinducer* drive balances the load electrically, through a unique, angular rotor shift of one motor. Result is a drive arrangement that takes less space than other trunnion drives . . . and facilitates automation of grinding equipment. *Twinducer* drive cuts maintenance costs, conserves power requirements and greatly extends gear-train life.

For complete information on the new *Twinducer* drive system, see your A-C representative. Or write **Allis-Chalmers,** Industrial Equipment Division, Milwaukee 1, Wis.

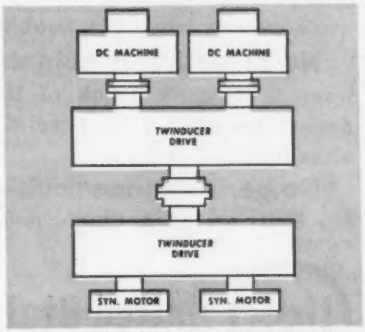


Diagram of Twinducer drive demonstration. Load is balanced electrically by a rotor shift mechanism in one of the twin synchronous drive motors. A-1514

This mark tells you a product is made of modern, dependable Steel.

It doesn't take long to deliver quality USS Grinding Balls!

No delivery problems. We don't actually catapult USS Grinding Balls—we're afraid it wouldn't make a hit with our customers. But we always ship them immediately—all the balls you need, exactly when you need them.

No selection problems. You can order from a complete stock of USS Carbon-Manganese and USS Alloy Steel Balls, in a range of sizes from ¾" to 4".

No performance problems. USS Grinding Balls are hard, tough, and uniform. Hardness surveys under direction and control of USS Research Center proved that maximum depth of hardness consistent with toughness is provided by our product in both carbon and alloy grades in all sizes. You cannot buy a better ball for your purpose!

Call our nearest Sales Office or United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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USS United States Steel

TRADEMARK

BIG SCREEN EXPERIENCE!

Allis-Chalmers knows the most, does the most about solving screening problems. With big-tonnage units like this 8′ x 16′ XH *ROM* scalper. Despite brutal pounding, it keeps producing . . . day after day. It works hard . . . earns more . . . and lasts a lot longer. How come?

It was built by the experts.

And Allis-Chalmers builds an ever-improving, complete line of horizontal and inclined vibrating screens. Famous names like *Low-Head* horizontal, *Aero-Vibe* and *Ripl-Flo* inclined screens cover the full range of applications — scalping, sizing, rinsing, washing, media drain and dewatering.

Ask your A-C representative for help with your screening requirements. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

ROM, Low-Head, Aero-Vibe and Ripl-Flo are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-1529

NEED A TAILORED CONVEYOR SYSTEM?

If you're the man who must make the decision on a materials-handling system, you've got a big job on your hands—whether it's a large system or small. You'll decide on design, construction and equipment—and you'll live with it for years.

One call to your Rex Engineer will help make sure your system is tailored specifically to your needs—that it speaks well for you by providing the most efficient operation, lowest maintenance cost and maximum freedom from down time.

Your Rex Man adds over 70 years' experience to your planning team—for he brings you the 70 years' experience of CHAIN Belt Company in solving countless bulk materials handling problems just like yours.

Complete Rex line assures a tailored system. Your Rex Man also offers you the industry's most complete line of equipment: conveyors—apron, belt, drag chain, and vibrating; bucket elevators; feeders—apron, belt, reciprocating plate, rotary table, and vibrating. So, he is free to recommend a system that meets your needs.

Call your local Rex Engineer when he can be most helpful—at the planning stage. CHAIN Belt Company, 4679 W. Greenfield Ave., Milwaukee 1, Wis. In Canada: Rex Chainbelt (Canada) Ltd., Toronto and Montreal.

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CHAIN BELT COMPANY

A call to CHAIN Belt adds a man to your staff, but not to your payroll

The tractor is an International Model R-195, powered by an RD-450 engine. Power is transmitted through a Fuller 5-speed Model 5-A-620, featuring overdrive in 5th gear, and an Eaton 2-speed drive axle.

18 tons . . . 100,000 miles a year

"Our tractors average over 100,000 miles per year, consistently hauling 16 to 18-ton loads, and we get excellent performance from our Fuller Transmissions," states Allan E. McGarity, Officer of the Harmony Blue Company, Inc. of Elberton, Georgia. "We feel that the reliability of the Fuller Transmissions has been a major factor in the excellent performance record of our hauling fleet."

For reliable, low-cost performance in your trucking operation, specify Fuller Transmissions.

See your truck dealer, or write to:

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EATON MANUFACTURING COMPANY
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in uranium ore processing...

TRONA®
SODIUM CHLORATE!

out-performs other oxidizing agents because of higher oxidizing power, economy and ease of handling

Experience proves that TRONA SODIUM CHLORATE is the best oxidizing agent you can use in the acid-leach process for recovering uranium values from its ores. $NaClO_3$ is more economical, too, because of its higher oxidizing power. It is rapidly and completely soluble; in the leaching circuit it forms a solution, not a suspension. Another advantage—Trona sodium chlorate shipping drums are suitable for re-use in shipping yellow cake. AP&CC, the largest domestic producer of sodium chlorate, has the knowledge, experience and facilities to produce a consistently better sodium chlorate for your milling operations.

TRONA® SODA ASH is used in acid and alkaline processes for the refining of uranium ores and as a pH modifier in the ore milling circuit. High quality Trona soda ash has applications also in the refining of lead dross and as an extractant of nonferrous minerals from low percentage ores by flotation.

Write for $NaClO_3$ facilities, technical data and applications bulletin. Also available —an attractive and functional wall chart for chlorate handling precautions.

TRONA

American Potash & Chemical Corporation

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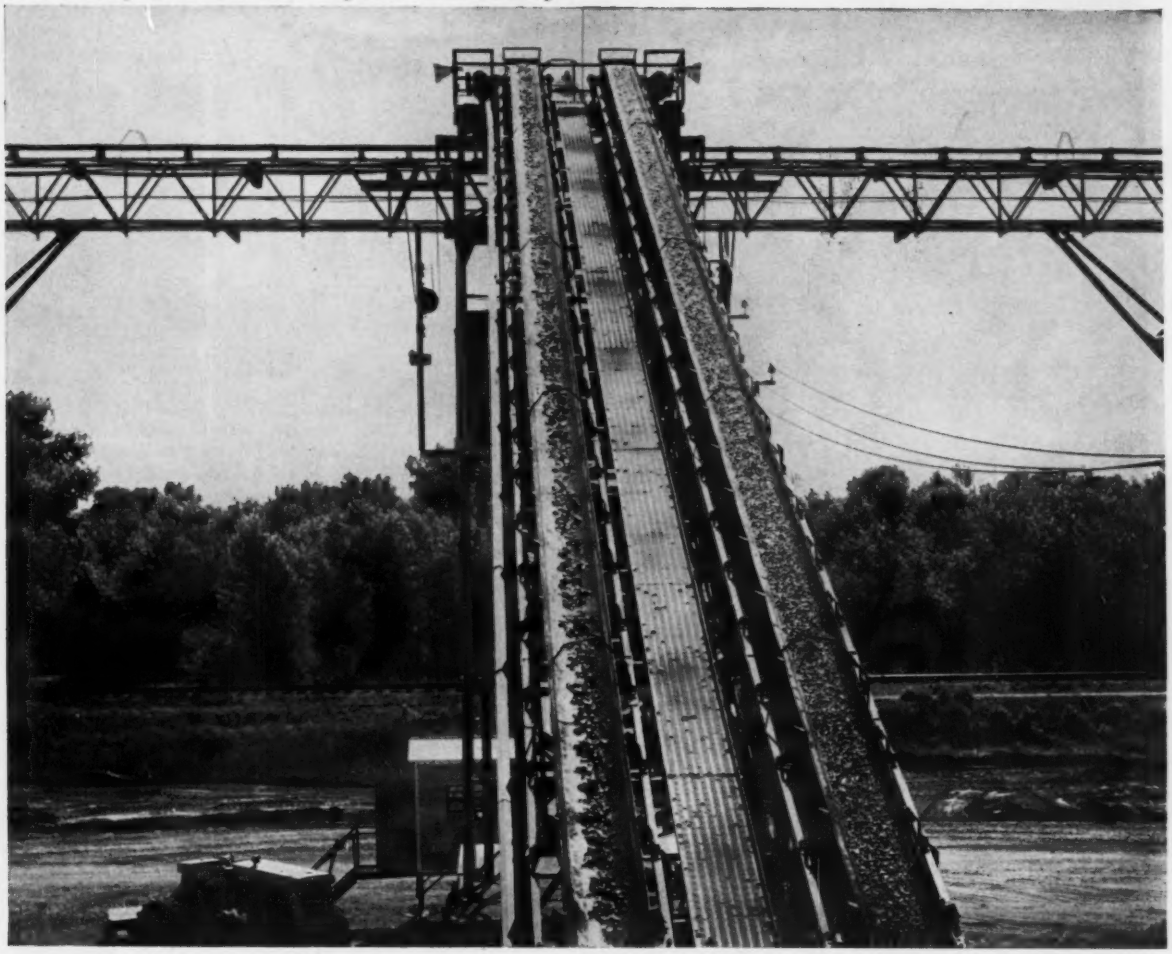
YTTRIUM • RARE EARTHS • *and other diversified chemicals for Industry and Agriculture*

An example of Avisco Rayons in Industry



Now, stronger, lighter-weight belts with Avisco XL-I rayon

Because of fabrics made from Avisco XL-I rayon fiber it is now possible to engineer stronger, lighter-weight belts.

Compared to the traditional fiber, fabrics of XL-I rayon have up to 60% greater tensile strength and 3 to 5 times the fatigue life.

XL-I rayon adheres without predipping. Flex characteristics are excellent. XL-I fabrics trough well, conform better to pulleys and rollers, readily absorb starting and shock loads. Their lighter weight requires less power for starting and running.

For help in improving your product with Avisco XL-I rayon reinforcement, send in the Quick Reply Coupon.

QUICK REPLY COUPON 3-19

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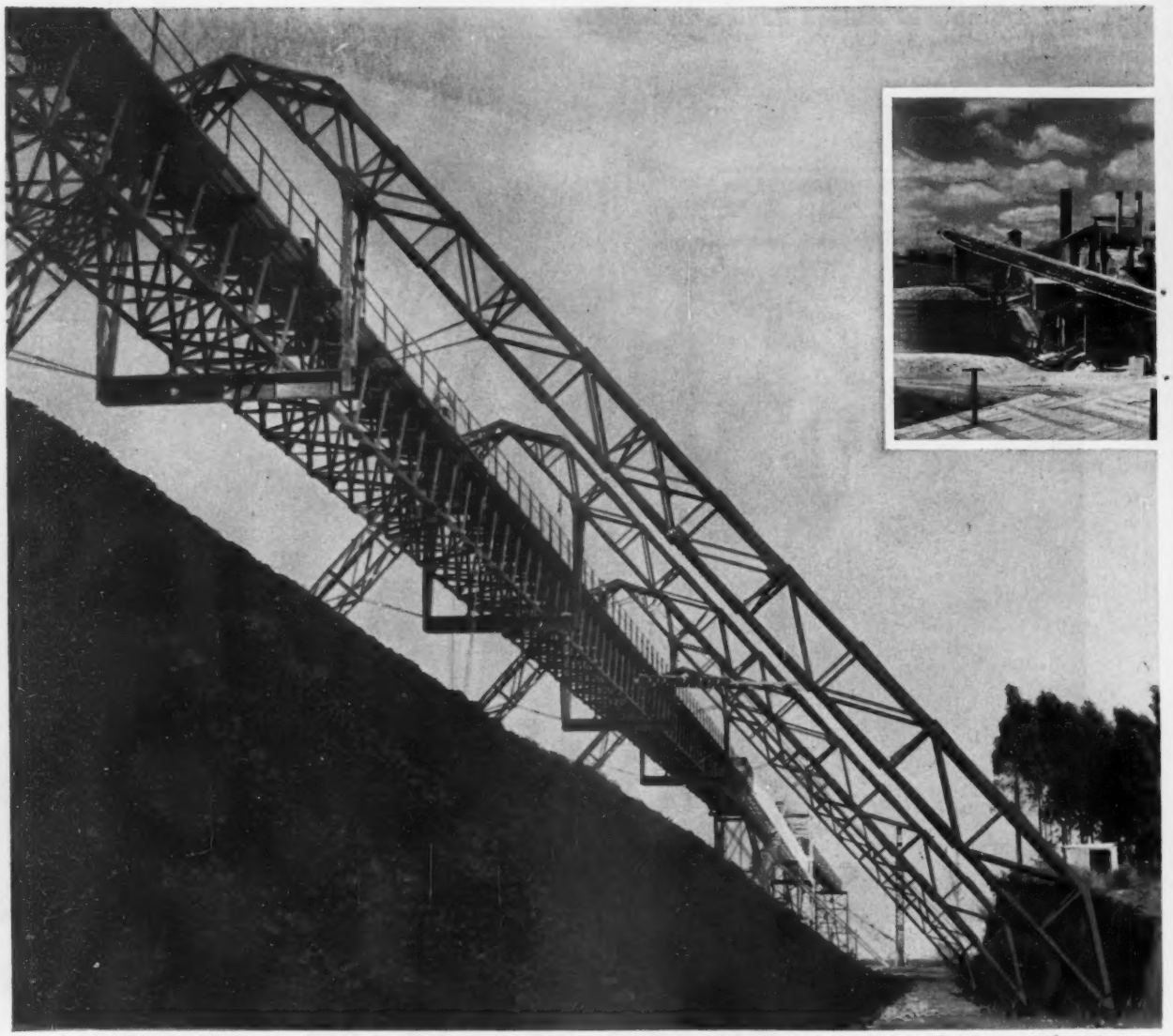
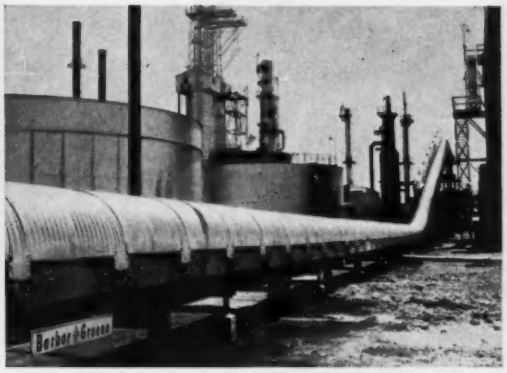


URUGUAY. Manganese ore is unloaded from ships, stockpiled, and reclaimed at this shipping terminal by a 2,655' Barber-Greene conveyor system. Notice the giant hurricane-proof cantilevered supports that clear this stockpile and under which the stockpiling conveyor is hung.

SOUTH AMERICA. Barite moves two ways on this reversible conveyor, from ship to stockpile, and from stockpile to ship.

DOMINICAN REPUBLIC. Gypsum is conveyed from face through crusher to stockpile at this remote mine.

MISSOURI. Dolomite flows from mine through crushers and screens to stockpile on Barber-Greene conveyors.



COLORADO. Gilsonite travels over five Barber-Greene conveyors through processing at this plant. The 487′ unit shown carries the wet materials from the filter plant to the melt tank.

MINNESOTA. Iron ore gets a fast ride from hopper cars to beneficiation plant on this heavy duty Barber-Greene conveyor.

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Big reasons why decades of profitable use are built into all Barber-Greene conveyors include: 1) 45 years of manufacturing experience that produces the finest conveyor components your money can buy; and 2) a conveyor engineering team that draws on the most complete stock of standardized components and the most imaginative design in the industry to make every job a blue chip materials handling investment.

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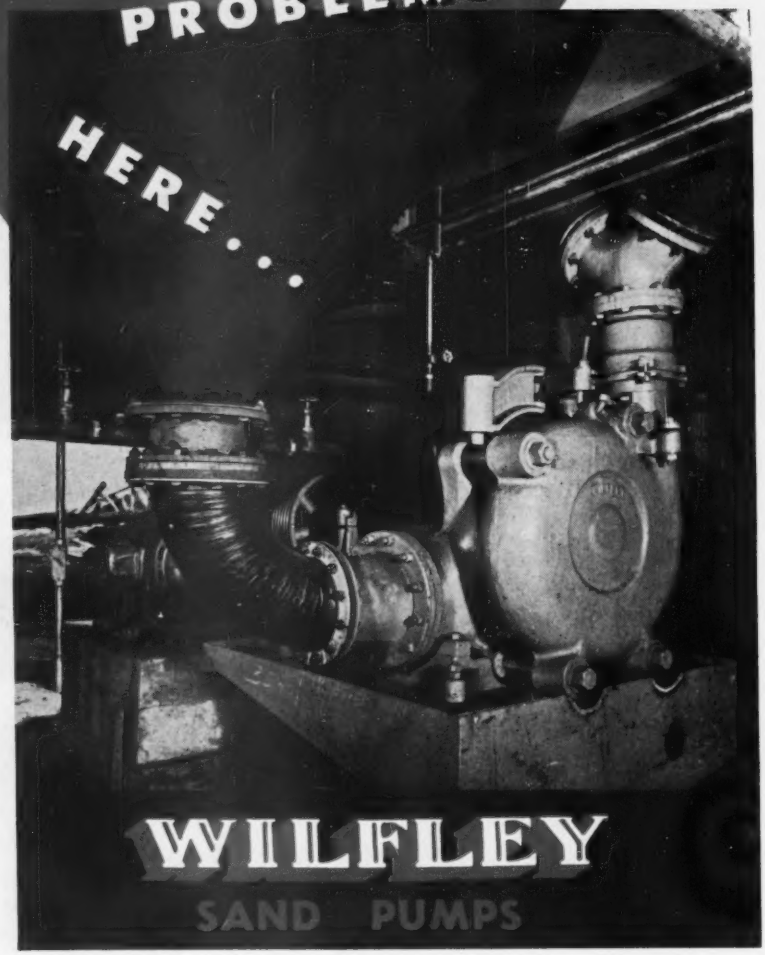

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What the 49th Parallel Really Divides

An Editorial

AL KNOERR

DURING A RECENT VISIT to the new mine and mill of the St. Lawrence Columbium and Metals Corp., 20 miles west of Montreal, Quebec, (See article p 99) we couldn't help but envy the climate which Canada has created for its mining industry. The 49th Parallel separates two countries—one which stimulates mining, and another in which mining is being throttled by unenlightened state and Federal legislation and a public which doesn't appreciate mining's contribution to the national economy. Let's take a look at the difference between the mining climates in the U. S. and Canada.

1. Canada has a Department of Mines and Mineral Technical Surveys headed by a capable cabinet Minister, the Honorable Paul Comtois. We don't have a cabinet officer who makes it his sole business to look after the best interests of the mining industry. In the U.S, mining affairs are all mixed up with fish and wild life, power administrations, forestry, Indian affairs, National parks and reclamation under the catch-all Interior Department. When one bureau decides to push public power and threatens producing mining properties, the poor miner has to slug it out with Washington on his own because no agency is legally constituted as his official champion. To settle such conflicts the Secretary can either develop twitches of schizophrenia, or lean in the direction which is politically most expedient.

2. In Canada, the mining laws are realistic. British Columbia threw out antiquated lode-claim and extra-lateral rights decades ago. We're still hanging on to the unenlightened mining concepts of 1872 even though the Hoover Commission exposed their flaws over 10 years ago.

Canada's laws concerning surface rights and mineral rights are so realistic that the 1953 claim staking boom which brought the St. Lawrence property into existence took place on private land, within sight of the evening lights of Montreal. In the U. S., public opinion has supported wilderness legislation which will make it virtually impossible for prospectors to enter some of the most remote and wild areas of the nation. Even the mining state of Michigan ruled out copper exploration in the remote Porcupine Mt. state park.

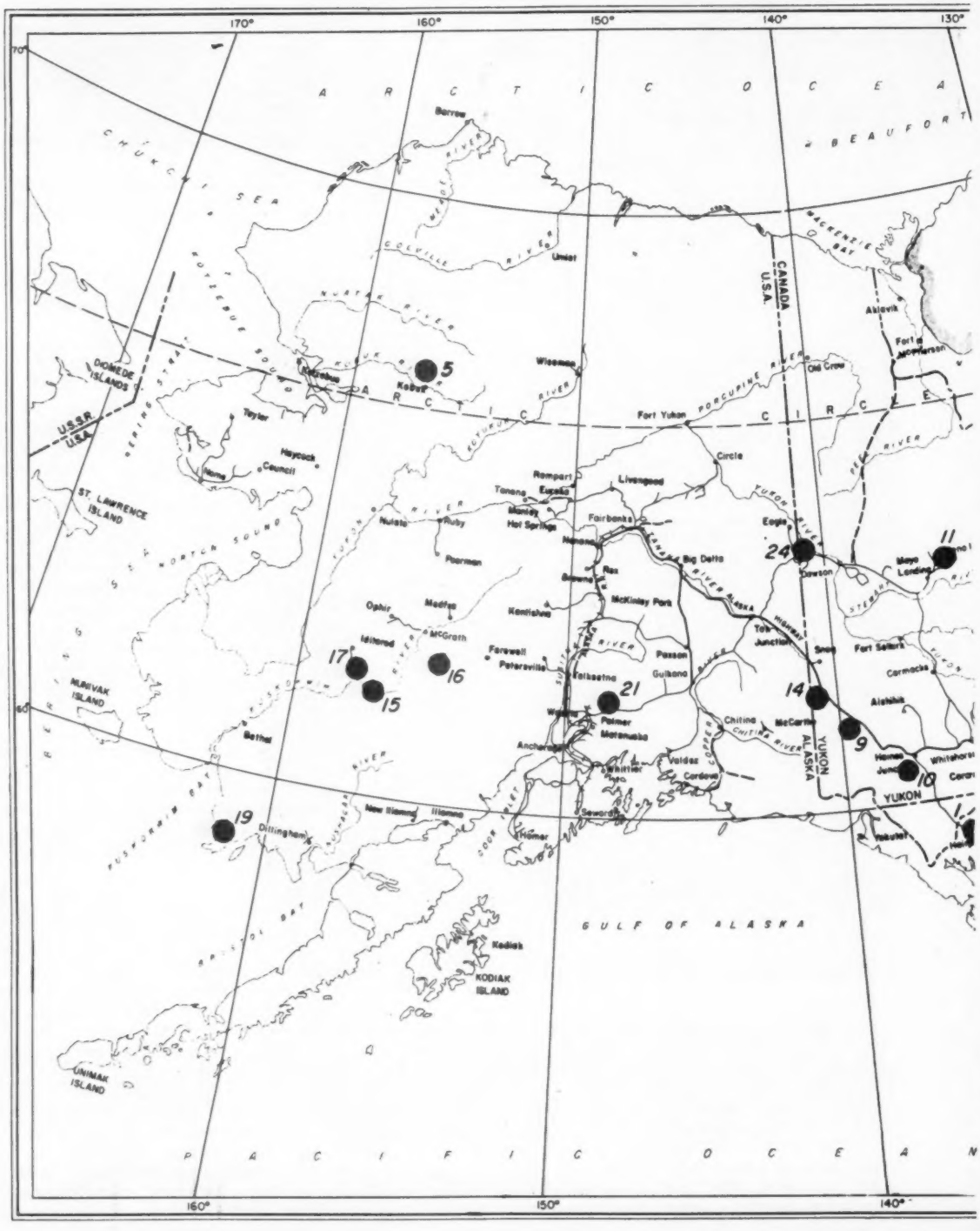
3. Canada's tax laws are framed to encourage new mining ventures. In the U.S. you're often beaten before you start because Federal administrations don't acknowledge that mining is a wasting asset and a decidedly risky business. (By the way, whatever happened to the 10-15% risk rates that we used to use in mine evaluation formulas?) Minnesota has lost over a half-billion dollars worth of mining venture capital, diverted elsewhere because of excessive taxes on iron ore. Much of that money went right into Canadian ventures where the mining climate is more favorable.

4. Canada has subsidized its gold mining industry when exchange values of the Canadian and U.S. dollar cut into the revenues of the Canadian gold producers. In the U.S., Government order L-208 shut down and virtually ruined the gold mining industry during World War II after all able-bodied eligible men had already gone into the Armed Forces.

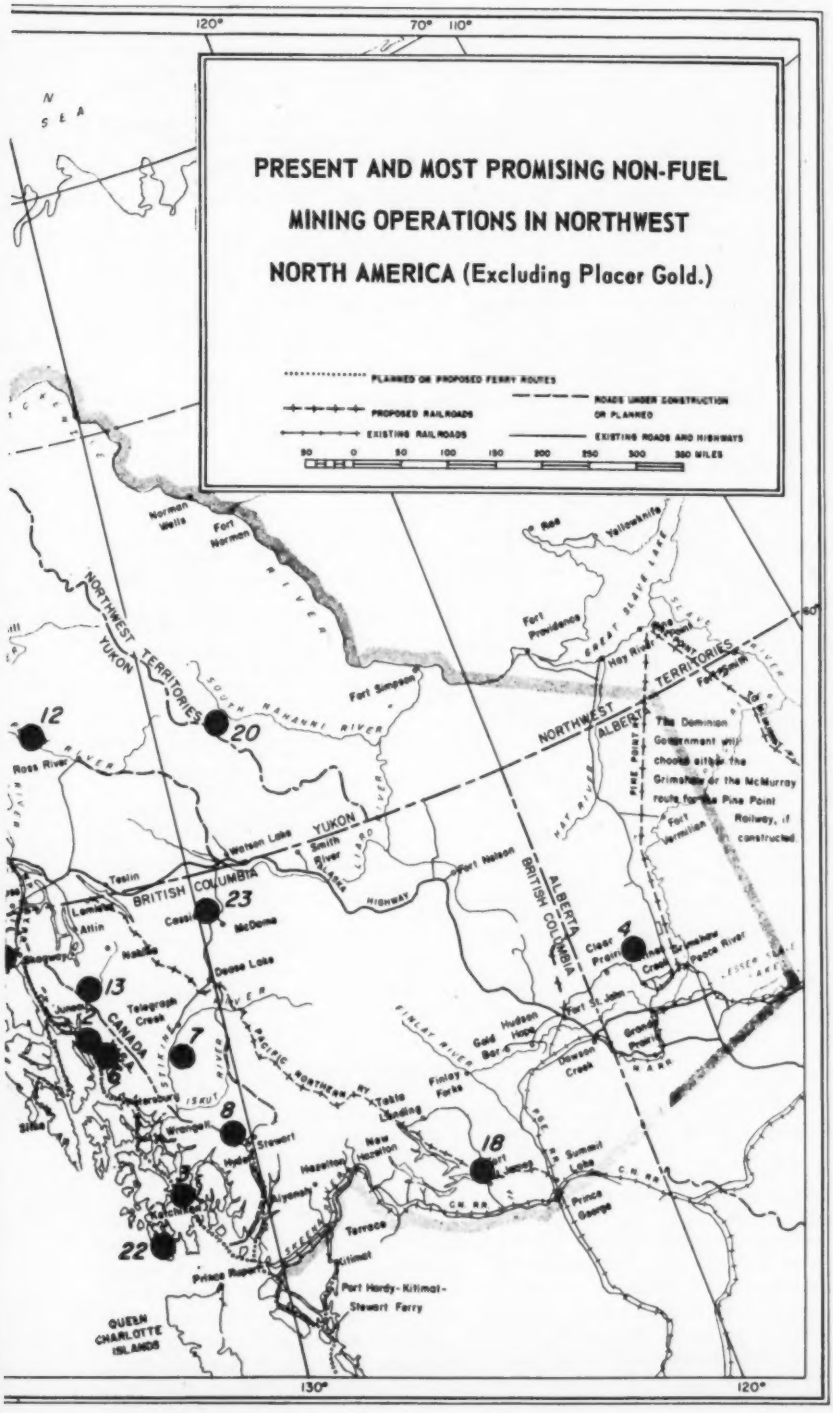
In this comparison between mining in the U. S. and in Canada, we're not implying that the U.S. industry lacks virility. On the contrary, it has had to be exceptionally resourceful to achieve its present dynamic state in the face of an unsympathetic public, and discouraging state and Federal legislation. But isn't it about time that we get exercised about the Ophir-making trends that are frustrating our industry, and worse still, denying us the chances of seeing more Okas in the U.S.?

As a starting point, let's push for a Department of Mines and Mineral Resources in Washington with a secretary of cabinet status. If we need a convincing argument to start the campaign, here it is: The value of all U.S. mineral production approximately equals that of all U.S. agricultural production. (See Statistical Abstracts of the United States, 1960.)

What's Ahead for Metals and Minerals



# of Northwest North America



RICHARD J. LUND

AN ASSESSMENT of the future metal and mineral potential of Northwest North America—the area outlined at left—was one important phase of a study recently completed by Battelle Memorial Institute. This was undertaken for the Alaska International Rail and Highway Commission, an independent U.S. Government agency established by Congress in 1956 to recommend as to the economic and military need for improved transport facilities between the South 48 States and Alaska. Future economic growth of the region will depend heavily on development of its mineral resources.

Attention will be confined here to non-fuel mines in the region—present and potential, based on reasonable projections from known occurrences. Highly significant oil and gas developments in the Kenai (south of Anchorage) and in N. E. British Columbia will not be covered. An evaluation of the liquid and solid fuel and hydro resources, other natural resources (including tourism), and recommended improved transport facilities are included in the complete Battelle report recently published by the U.S. Government.

The map shows the location and the table the salient features of present and potential mining operations that appear to be feasible for development in the next two decades. Placer gold is not included, since it constitutes a waning industry that will black out almost completely in Alaska in a few years unless the price of gold is boosted substantially.

Of all the locations shown, only four are present producers with a reasonable record of steady output: No. 11, the United Keno Hill Mining Co. in the Mayo silver-lead-zinc district of central Yukon; No. 23, the Cassiar Asbestos operation; No. 19, the Goodnews Bay Mining Co.'s platinum dredging operation, and No. 15,

Mr. Lund is Assistant Technical Director, Battelle Memorial Institute, Columbus 1, Ohio.

[1] Transport Requirements for the Growth of Northwest North America. Report to Congress by Alaska International Rail & Highway Commission, volume 2 of 3-volume set, House Document 176, 87th Congress, 1st Session. Gov. Printing Office, Washington, September 1961.

Table 1. Potential Metal and Mineral Nonfuel Output from Most Promising Deposits in Northwest North America*

Map No.	Deposit	Metal or Mineral	Company Interested	Estimated Size, tons of ore	Estimated Grade, per cent	Estimated Annual Output: Short Tons	Estimated Annual Output: Value $	Remarks
1.	Klukwan	Iron	Columbia Mining Div., U. S. Steel	500,000,000	12	2 million conc, or 1,050,000 steel	16,000,000 73,500,000	Reserves of alluvial fan only—huge lode reserves of 15-20% Fe in addition. All titaniferous. Might use cheap hydro for electric smelting.
2.	Snettisham	Iron	W. S. Moore	400,000,000	17	325,000 conc. or 175,000 pig	2,780,000 8,750,000	Lode deposit. Titaniferous. Might pretreat electric smelt with nearby potential hydro.
3.	Kasaan Area (several deposits)	Iron	Mt. Andrew Mining Co. (Utah Const.)	25,000,000	40–50	600,000 conc.	4,280,000	Several small replacement type deposits similar to Vancouver Island.
4.	Hines Creek	Iron	Premier Steel	500,000,000	33	350,000 steel	25,000,000	Gas, oil, or hydro nearby for cheap smelting fuel.
5.	Kobuk	Copper	Bear Creek Mining (Kennecott)	100,000,000	1.5[a]	162,000 conc.[b]	24,000,000	Has had most drilling of any deposit in the Area.
6.	Sumdum	Copper	Moneta Porcupine and Others	30,000,000[c]	Less than 1[c]	108,000 conc.	16,000,000	Too low grade to make ore now.
7.	Scud River (2 Properties)	Copper	Amax, Newmont, Hudson Bay, Kennecott	50,000,000[c] 50,000,000[c]	0.75–1.50 0.75–1.50	108,000 conc. 108,000 conc.	16,000,000 16,000,000	Several disseminated deposits of the porphyry type that appear promising; improved transportation needed.
8.	Granduc	Copper	Newmont	30,000,000	1.8	195,000 conc.	29,000,000	More drilling being done in '61.
9.	Quill Creek	Nickel-copper	Hudson Bay	730,000	2.0 nickel 1.4 copper	4,000 conc.	2,000,000	Might be of interest as small operation for Japanese market.
10.	Johobo	Copper	Johobo Mining	?	?	4,000 conc.	1,000,000	Ditto
*11.	United Keno Hill	Silver-lead-zinc	United Keno Hill	550,000	6.6 lead 4.9 zinc 38 oz silver	30,000 conc.	9,000,000	Promising ground in district might double production if silver price is boosted substantially.
12.	Vangorda Creek	Zinc-lead-silver	Prospectors Airways	10,000,000	4.84 zinc 3.05 lead 0.3 copper 1.8 oz silver	70,000 conc.	8,000,000	Definitely submarginal at present Zn-Pb prices.
13.	Tulsequah	Zinc-lead-silver	Cominco	?	Mainly zinc and silver	30,000 conc.	5,000,000	Operated 1950–57. Needs higher Zn-Pb prices.
14.	Canalask	Nickel	Canalask Nickel	550,000	1.7	4,000	1,400,000	Might produce small tonnage for Japanese market.
*15.	Red Devil	Mercury	De Coursey-Brewis Minerals	?	2.0	160 mercury	1,000,000	Probably close to marginal at present mercury price.
16.	White Mountain	Mercury	Cordero	?	1.5–2.0	160 mercury	1,000,000	Probably needs over $200 per flask mercury and more development.
17.	DeCoursey Mountain	Mercury	DeCoursey-Brewis Minerals	?	1.5–2.0	160 mercury	1,000,000	Ditto
18.	Pinchi Lake	Mercury	Cominco	Large	?	400 mercury	2,000,000	Produced over 50,000 flasks in World War II. Large reserves left, but need higher mercury price.
*19.	Goodnews Bay	Platinum	Goodnews Bay Platinum	?	?	12,000 oz.	1,000,000	Only U. S. producer of primary platinum metals. About 10-yr reserves.
20.	Flat River	Tungsten	Canada Tungsten Mining	1,300,000	2.5 WO_3	2,500 conc.	3,200,000	Definitely scheduled for operation in 1962.
21.	Sutton	Limestone	Kaiser Permanente	?	?	500,000 bbl. cement	2,500,000	Source of limestone for 500,000 bbl/yr cement plant planned.
22.	Dall Island	Limestone	Ideal Cement	300,000,000	High lime	1,500,000	1,500,000	Excellent stone for cement—for possible shipment to plant in Pacific Northwest.
*23.	Cassiar	Asbestos	Cassiar Asbestos	15,000,000	10	30,000 asbestos	8,000,000	High grade, low-iron chrysotile—much long fiber.
24.	Clinton Creek	Asbestos	Cassiar Asbestos	5,000,000	10	30,000 asbestos	8,000,000	Ditto. Projected operation when market justifies development.

*Possible development based on potential market needs to 1980.
*Present producers.
[a] Grade probably required to make ore—higher than shown by drilling through 1959 season.
[b] Might be around 50,000 tons of blister copper smelted near the mine.
[c] Highly conjectural—more drilling needed to prove size indicated.

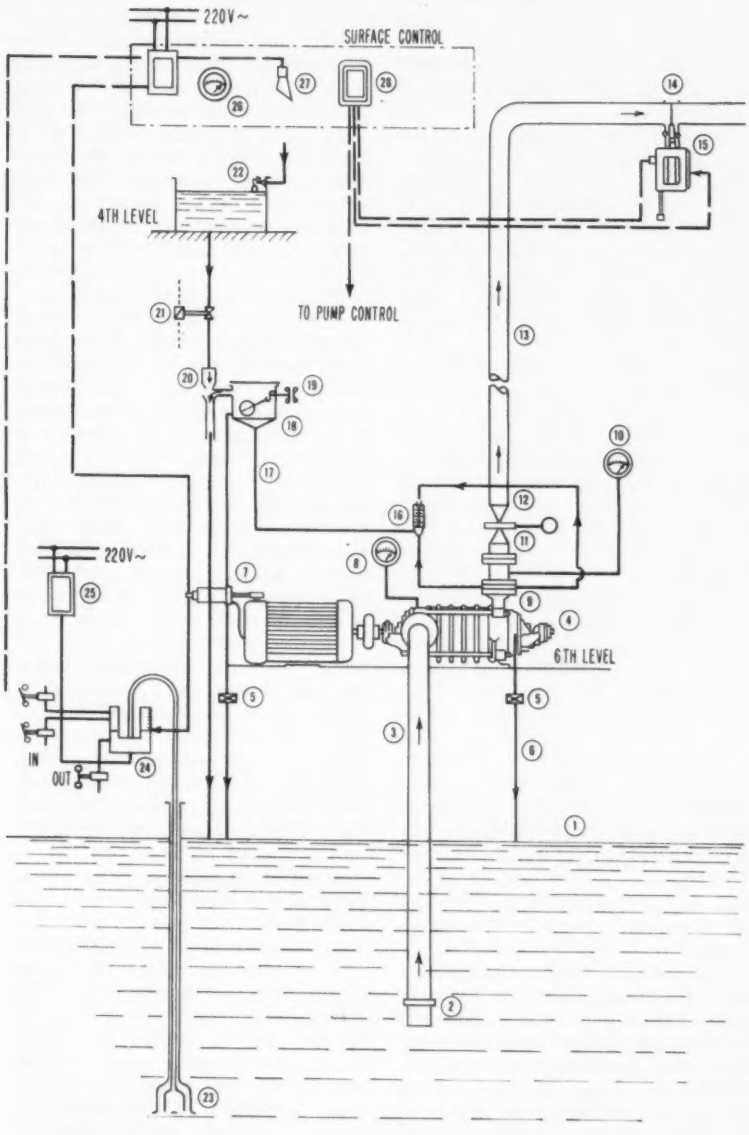
the Red Devil mercury mine of DeCoursey-Brewis Minerals, Ltd.

The figures for estimated output in the table are but guesses at the size of operation deemed feasible for development in the next 20 years, based roughly on present prices.

Battelle concludes that, except for possible operation of the deposits herein listed, any major metal and mineral (non-fuel) developments in the area will have to come from new discoveries or from further exploration of the hundreds of reported occurrences that cannot now be assesed. A few of the more promising "showings" not indicated on the map, on which recent work has been done are: (1) a copper-nickel deposit beneath Brady Glacier at the north end of the Alaska Panhandle; (2) a copper deposit on North Lakes about 100 miles northwest of Watson Lake in southeastern Yukon; (3) a rich silver-lead deposit about 25 miles southwest of (2) in southeastern Yukon; and (4) a copper deposit south of the Scud River deposits (No. 7 on map). A recent news item[1a] mentions additional

(Continued on p 190)

Flowsheet of Automated Pump Station On 6th Level in Meggen Mine



LEGEND

1. Pump sump
2. Strainer unit on suction pipe
3. Suction pipe
4. Pump
5. Check valve
6. Drain pipe
7. Adjuster unit
8. Vacuum meter with contact system
9. Ring insert
10. Pressure gage with contact system (Range: 40% above pump end pressure)
11. Check valve
12. Slide
13. Discharge pipe
14. Norm diaphragm with ring chamber measuring flange
15. Volume flow measuring device
16. Reversing valve
17. Evacuation pipe
18. Tank with float valves for evacuation system
19. Micro snap switch
20. Water jet-air suction unit
21. Electro-magnetic valve
22. Float valve
23. Twin diving bell
24. Mercury U-tube
25. Power connecting and rectifier unit
26. Water level indicator
27. Horn signal
28. Water meter and power connecting unit

Pump Automation Cuts Meggen Mine Costs

BASED on the successful operation of an automatic pumping station on the 6th level of the Meggen mine, "Sachtleben" AG, West Germany's leading pyrite producer, now plans to automate the 4th level pumping station.

The company estimates that automation of the entire mine pumping system will save 600 pump shifts per year as well as extra pay on Sundays and holidays and the wages for hoistmen and supervisors required during those periods. The yearly savings amounts to about 30,000 DM ($7500) per pump station.

In 1958, water pumped from the mine amounted to some 2,238,000 m^3 ($1m^3 = 264.2$ gal). The daily high in January then was some 8600 m^3 and the minimum in November 5050 m^3, giving a daily average for the year of 6400 m^3. During 1959, a dry year, the total amount of water pumped was 1,265,000 m^3, the daily average for the year being 3470 m^3. The average daily amount of water pumped during the first six months of 1960 was 4300 m^3 (1,135,944 gal).

Because the mine water has a pH ranging from 2.5 to 3, all centrifugal pumps are made from special alloys (castings containing from 28% to 30% chrome have been found satisfactory) to withstand the acidic water; suction pipes in part are made from a plastic (PVC); and discharge lines are rubber-lined steel pipe. The pumps operate against manometric heads of 60, 160, 190, and 290 m WS. Capacity of the pumping equipment available, including stand by units, amounts to 1440 m^3 (380,409 gal) per hr. Power requirement is around 969 kw. The pumps, driven by 2- and 4-pole ac motors, have power demands of 23, 30, 100, 170, and 250 kw. (Operating voltage for motors

Data presented in this article were abstracted from a paper by Maschinenbetriebsfuhrer Josef Hennes of "Sachtleben" AG published in the July 1961 issue of ERZMETALL.

with a power demand of 30 kw is 380 v, and for the larger motors 3 kv.)

Although one-stage pumps are used when pumping heads do not exceed 60 m, localities where high heads prevail are served by multi-stage units. Four pumping stations are now in operation in the mine, but reorganization of the mine pumping system will eliminate two of them, leaving major pump stations on the 4th and 6th levels in the Sicilia shaft.

When reconstruction plans for the 6th level pump station were under study three years ago, designs did not include full automation of pumping operations. Faced with an urgent need for cutting costs in 1958-59 to put the mine on a more competitive basis, management studied and designed the automated installation shown above. Based on gratifying results obtained during 1½ years of automatic operation, management decided also to automate the 4th level pump station. The work is expected to be completed this year.

Equipment data covering the 6th level pump station are: Power requirement, 170 kw; motor speed, 2950 rpm; motor voltage, 3 kv; slip ring, motor protective system type P 33. Pumping equipment proper consists of a five-stage turbo pump with hydraulic thrust compensation. Starting point at zero output equals 34 kg/cm^3; manometric head, 290 to 300 m; suction height, 4 m; water pumped, 130 m^3/h; and specific speed of rotor, 25. Pumps of this capacity and with a specific rotor speed are suitably started against the closed slide or gate valve. At zero output, the pump requires about 50% of the nominal moment (Nenn-Momentes), based on the pump speed.

Switch and Control Devices

Available equipment units in the 6th level pump station were reconstructed for remote control, including the high-tension capacity switch serving the pump motor, rotor starter, rotor short circuit arrangement, and the control slide.

The motor capacity switch, built into a ring capacity field (Ringleistungsfeld), was fitted with a remote motor starting unit with an electromagnetic release. A multi-pole auxiliary switch operates in conjunction with the capacity switch, which, upon closing of the capacity switch, simultaneously causes a consecutive switch operation and sets in motion control reactions. The motor drive assembly contains a hand starter for manual operation of the starter switch in the event of failure or damage to the motor drive proper.

The rotor short-circuit arrangement on the pump motor was equipped with an electro-adjusting device and a rack drive. In addition, there was built into the motor an end switch actuated by the short circuit bridge for carrying out specific tasks. The rotor short circuit arrangement, in an emergency, can be actuated manually after a minor adjustment.

More difficult was the mechanization of the available motor starter. This unit had seven switch positions with a total switch angle of 252° without rotation. In its place there was selected a step switch drive actuated by a 4-pole ac motor, with the squirrel cage rotor fitted with a worm gear drive arrangement. One end of the drive shaft contains a drive finger for the starter. The other end of the drive shaft actuates a switch designed to hold the starter motor in proper position after each switch change. This drive shaft end also has a spring pressure brake to prevent idling of the motor after any switch change. When the motor is on voltage, the brake is released electromagnetically by a similarly directed voltage. A timing relay controls the time period between each switch change. After switching off the pump motor, return of the starter is effected by bypassing the time relay. It is possible to operate the starter manually should this be desired.

The hand-operated slide of the centrifugal pump (made from castings containing 30% chrome) was rebuilt for mechanical control with a ⅓₀-hp motor furnishing the required power. Opening and the respective closing time period each last 30 sec. Between the motor and the slide shaft there is placed a slide coupling as a safety measure. Micro snap switches shut down the drive motor when the slide shaft reaches one or the other end position. The switches continue to operate even if the movement of the switch pole or rod is only ⅓₀ mm/hr, and, as a consequence, eliminate the flutter of the air breakers which are required for control of the slide.

Air Evacuation Contrivances

Unless of special design, centrifugal pumps cannot take load when dry and often require priming after a shutdown. Generally, this is accomplished by filling the pump casing with water, and eliminating air present. In an automated pump operation, this is an all important point. To obviate suction failures, a special air evacuation system was included to keep the pump primed at all times. This is one of the most important auxiliary units of the plant and it provides the vacuum required to remove any air present in the pump casing. This is accomplished by means of a water jet-air suction unit flanged to a water tank with two float valves installed about 200 mm above the pump. The water tank in turn is connected to the pump discharge pipe by an acid-resisting pipe system fitted with a valve equipped with an hydraulic power piston and an alloy-steel pipe insert with inlet and outlet connections. Drain pipe serving the water tank contains a check valve which automatically closes during the air evacuation period and prevents outside air from entering through the drain pipe.

The air evacuation system is controlled by an electro transit valve. When switched on, this unit will direct plant water to the water jet-air suction unit and activate it, thus causing vacuum in the suction pipe, pump, water tank, and cylinder chamber of the hydraulic valve. The valve piston, assisted by spring pressure, moves toward the discharge end, opening the line to the water tank. Water then rises in the suction pipe, enters the pump casing, and finally reaches the water tank. Here, the rising water lifts the floats attached to angle levers of the two float valves installed. The levers, in turn, cause two switch plungers to move in a horizontal direction until they actuate the two micro snap switches outside the water tank, which, in turn, provide the impulse for the pump motor starter switch. At this moment the pump casing is filled with water, all air having been evacuated.

After the pump has reached top speed, the pressure built up in the discharge pipe just below the slide returns the power piston of the hydraulic valve, closing the valve and the air exhaust line to the water tank. The drain pipe serving the water tank is equipped with a check valve, which remains closed during the air evacuation period. It opens immediately after completion of the evacuation period and permits water in the tank to drain. The system is then ready to start another evacuation cycle. The water jet-air suction unit requires water supplied at a constant pressure of about 10 kg/cm^2. Consumption is 150 liters. The system described operates so effectively that use of a foot valve in the suction line has been found superfluous.

Control of Water Level

Units serving the water level control system operate electro-pneumatically. A diving bell made from PVC plastic material is placed in the pump sump with the open end covered with a screen with large openings facing

the sump bottom. The closed end of the bell is attached to a plastic pipe leading to the pump room and connected there to a U-tube-type pressure gage. The base of the gage is made of steel, and the two legs are short lengths of glass pipe. Both pipes contain fused-in platinum contacts. In one leg, the contacts extend into the pipe for a distance of 10 cm WS and in the other leg 5 cm WS. The pressure gage proper is filled with mercury and chemically refined paraffin oil.

The shorter contacts mentioned are connected to resistance coils, while the longer contacts serve to control operation of the pump and work the horn signal on the surface when changes in water level beyond set points occur. In a measuring range from 0 to 4 m, any one of the two contact units can be used as a limit contact for pump control and operation of the horn signal. For instance, a pump can be shut down at 0.5 m WS, started at 1.6 m WS, and the horn signal operated at 1.7 m WS. The glass leg with the shorter contacts serves the water level indicator on surface.

No Moving Parts

Operation is as follows: Air pressure in the diving bell rises in accordance with the rise of the water level in the sump. Any increase in pressure, therefore, will raise the mercury in the U-tube. The 10-v current maintained in the long platinum contacts is provided by a special rectifier unit connected to the main power line. When the mercury rising in the leg reaches the "start" contact, a relay combination is actuated which, in turn, starts the pump. Likewise, optical and acoustic warning units on the surface are set in motion when the mercury touches the "alarm" contact. The acoustic warning unit can be stopped by a time switch.

The resistance coils attached to the shorter platinum contacts in the other U-tube leg are short circuited the moment the rising mercury touches the contact, thereby altering the total resistance to correspond with the height of the water level in the sump. In the measuring current circuit a current flows which is proportional to the residual resistance and height of water level which is indicated by a voltage meter with markings in m WS on the surface (Ohm's law).

Although a single diving bell assembly can serve several water level indicators, it is advisable to provide a stand-by in the event of bell failure. As a consequence, the bell used at Meggen is a two-bells-in-one affair with pipe lines interconnected, the outer bell protecting the smaller inner bell. The installation described is designed for positive operation and low upkeep costs. It uses no moving parts such as floats, levers, rolls, cables, gears, bearings and electrodes.

Safety and Control Devices

The pump discharge pipe contains a pressure gage which, by being constantly exposed to operating pressure even during shutdown periods, controls the water column rising in the discharge pipe. A centrifugal pump with hydraulic slide equalization must be started against pressure equivalent to the operating pressure. In an emergency, pressure induced by slide choke will suffice. The contact pressure gage is set at 85% of the operating pressure. Should the static pressure in the discharge line fall below the point set, because of pipe leakage, the contact pressure gage would reverse, thereby preventing start of the pump and simultaneously indicating operational trouble by signal light. An additional task given the contact pressure gage is to control the operating pressure required during pumping periods. If the operating pressure falls, the pump is shut down with minimum delay, and the trouble indicated by signal held in "on" position by a check flap relay. This unit prevents (until manual reversal) the starting of the pump and thus facilitates search for the defect causing the operational trouble.

The vacuum in the pump suction line is controlled by a contact vacuum meter. Excessive fall of vacuum will shut down the pump and the light signals will remain "on" until the check flap relay is reversed manually. Operation is similar to that taking place in the contact pressure gage system mentioned before. The relay combinations connected to the finger contacts of the vacuum meter and contact pressure gage are ultra-sensitive relays with condenser delays. With a switch capacity of 15A, the relays work on very low control currents which results in long finger contact life. The hydraulic load on the control devices is about 50% of the scale end value. Temperature of the motor and pump unloading drain water is controlled by built-in thermostats. If motor and pump water temperatures rise above set points, the pump is shut down and the situation indicated by signal lights on the surface and underground. Check flap relays hold the signals and prevent start of pump until they have been reversed by hand.

Water flow from each pump is controlled near the point of discharge. Here, a ring chamber measuring flange with a norm diaphragm is built into the horizontal section of the discharge pipe. The water flowing through the pipe causes different high pressures to develop in front of and behind the diaphragm. The difference between the two pressure values or effective pressure (Wirkdruck) stands in certain relation with the size of water flow. It is measured by a differential pressure gage filled with mercury and paraffin oil resembling the U-tube unit serving the water gage indicator circuit. One difference is that the platinum contacts in the glass legs are fused-in at squarish rising intervals. Connected by electric resistance coils, they consequently form a step resistance. Rectified current is supplied by a power line connector unit. The step resistance, constant voltage of the current supply, and a water flow indicator form a current circuit. The effective pressure causes the mercury in the gage to rise and when it touches the contact to regulate the step resistance in such a manner as to generate within the current circuit a current proportional to the water flow. This current is constantly registered on an ac counter unit graded in cubic meters.

Flow Safeguards

The second contact-equipped leg of the gage controls the lowest pump production. In this unit the platinum contacts are placed individually on a bracket clamp. The contact that still can be reached by the mercury during normal pump output is connected into the safety current circuit of the automatic system via a sensitive relay. If the mercury does not reach the contact after a determined time period, the pump is shut down and the signal lights activated. This can be caused by a defective or leaky pipe section in the shaft. In other words, the pump output must flow out of the pipe line at a set point and not in the shaft, or the pump will shut down.

All auxiliary control units operating on 380 v, the 6 ampere-air protectors, and the relays for control and delay of switch operations are housed in cast-iron casings distributed throughout the pump room. Here, also are a transformer with a capacity of 1 kva at 380/220 v, signal light system with its check flap relays, and a lockable pushbutton unit through which the pump can be started and stopped after by-passing the water level system, if this is desired.

The pump can be started only when all functions of the control units are coordinated and set standards as to water levels, equipment temperatures, pressure and vacuum in pipe lines,

and others prevail. When this is the case, the operating current circuit is closed and a signal light underground and on the surface indicates that the pump is ready. Supervisors can see at a glance the status of the plant at all times. For instance, if the discharge line has drained during a pump shutdown, the contact pressure gage reverses, the light indicating that the plant is operational goes off and the signal showing no water in the discharge line goes on. On the other hand, if the plant is operational and the water level control system or limit controller gives the impulse to start the pump then the electro valve serving the water jet-air suction unit is opened to start the air evacuation system. Suction pipe, pump and tank with float valves are filled with water. The floats rising in the tank actuate the snap switches outside the tank to operate the motor drive on the capacity switch and subsequently start the pump motor proper.

Reversing the snap switches will close the electro valve. A drop-delay time relay holds the tension for a few seconds until the speed of the pump is high enough to take on suction by itself. With the capacity switch there is simultaneously operated an auxiliary switch coupled to the main starter switch which supervises several control and switch operations via air breakers and time relays. A time relay, for instance, controls the time period between start of the motor and the first starter step. The starter will work only after the relay goes into action. Another time relay control effects a timely supervision of the starting process; it must be completed in a set time period or the plant will shut down. This reduces to a minimum any starter trouble through slippage. The starter is advanced in steps to the end position by the starter drive mechanism.

During this process a cam switch coupled to the starter shaft cuts in an air breaker unit, which, in turn, puts the air breakers of the electro adjuster and the slide motor under tension. The adjuster starts, lifts the motor brushes, and short circuits the rotor of the motor. While this takes place, a short circuit bridge actuates the end switch mentioned, thereby ending supervision of the starting process. The slide motor, which starts simultaneously with the electro adjuster unit, opens the slide in 30 sec. When in end position, the slide actuates the end position switch and stops the slide motor. Reversal of the end position switch will put under tension another air breaker which controls the signal light on the surface showing that the slide is open. In addition, this air breaker when attracted will also control the pump operating pressure and pump output which must prevail when the slide is open.

Operation of the pump is now fully supervised by the control units in action. When the lowest water level in the sump is reached, the water level control system sets the pump shut down circuits in motion. A drop-delayed time relay causes a slight delay in these circuits to permit closing of the air-breaker-operated regulator slide. When the time relay drops out, the control current circuit opens and the output switch, via an air breaker, reverses the starter unit. Weekly plant inspection carried out by a mechanic and an electrician requires about 2 hours. During the 1½ years the plant has been in operation, no trouble has been experienced.

Bunker Hill Uses Stainless Valves In Critical Process Control Points

S. H. KELLER

THREE of the critical areas of Bunker Hill Co.'s electrolytic zinc process flowsheet (see opposite page) have been transformed from a threat to smooth operation to durable, low-maintenance installations. Steel diaphragm and plug valves in the leaching section and in the sulphuric acid plant—where they were a source of process interruptions—have been replaced with Aloyco 20 stainless steel double disk gate valves.

Valves employed in the leach tank system are particularly vulnerable to corrosive attack and mechanical failure because of the chemical solutions handled and the severe conditions under which they operate. Among the substances encountered in this hydrometallurgical process are sulphuric acid in 93% concentrations, hot zinc sulphate, spent acid electrolyte and various solutions containing impurities and solids. Contributing to the corrosion problem are the elevated solution temperatures in the lines, which vary from 95°F to 205°F (35°C to 95°C).

The process begins by roasting complex zinc concentrates. The roasting furnaces convert the zinc sulphide in the ore to acid-soluble oxides and sulphates (calcine) and at the same time produce sulphur dioxide, which is used to make the sulphuric acid employed in leaching. The calcine is then leached in a spent electrolyte of dilute sulphuric acid just returned from the electrolytic cells, plus some additional 93% sulphuric acid. In the leach stage, the roasted concentrate is added in measured amounts to assure the optimum recovery of acid-soluble zinc and precipitation of impurities such as silica, iron and aluminum.

After the leaching step, the leach pulp and the pregnant zinc-rich solutions are put through Burt filters, and the filtrates are purified by the removal of copper, cadmium, antimony and cobalt. The puried filtrate is run by gravity to the electrolytic department, where metallic zinc of high purity is deposited on aluminum cathodes in the cells during the electrolytic process. This is the source of the spent electroylte used in the leaching process.

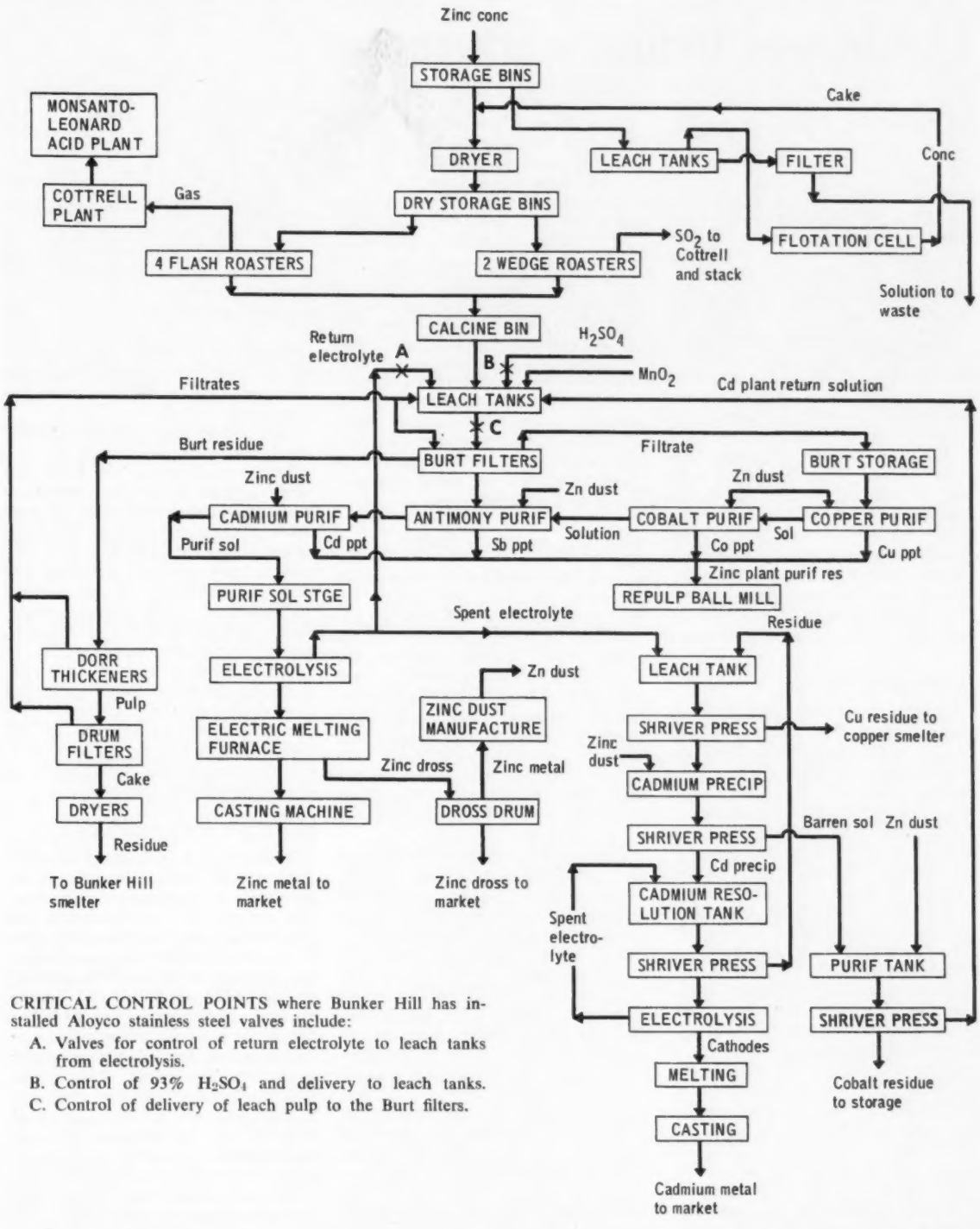
A breakdown of the process fluids showed that they included hot zinc sulphate solution containing 220 grams per liter of Zn, 0.20 to 0.50 gpl of Cu, and lesser amounts of Mn, Sb, As, Cd, Ni and Co. Sulphuric acid in 93% concentration, sulphuric acid electrolyte containing from 50 to 60 gpl of Zn, and solids up to 75 gpl were also present. Varying amounts of silica, gypsum and basic ferric sulphate were also carried in the leach pulp. Line pressures were up to 90 psi, and temperatures varied from 95°F to 205°F (35°C to 95°C), further aggravating corrosion in the control system.

In the sulphuric acid plant, where SO_2 is converted to H_2SO_4 after being run through Cottrell precipitators for dust removal, the stainless valves also control acid flow.

Valve stem corrosion, a common

Mr. Keller is assistant plant superintendent at the Bunker Hill Co., Kellogg, Idaho.

Bunker Hill Co. Zinc Processing Plant (with By-Product Flowsheet)



CRITICAL CONTROL POINTS where Bunker Hill has installed Aloyco stainless steel valves include:

A. Valves for control of return electrolyte to leach tanks from electrolysis.

B. Control of 93% H_2SO_4 and delivery to leach tanks.

C. Control of delivery of leach pulp to the Burt filters.

problem when low alloy valves are used in 99% sulphuric acid handling, was also avoided by use of the stainless steel valves. The valves were installed in transfer lines to prevent the possibility of deterioration when concentrated acid entrained on the rising stem is diluted by atmospheric moisture and is rendered highly corrosive. Lower alloy stems in such use become roughened, tear the packing and cause leakage.

The valves which Bunker Hill installed to improve the reliability of control valves and lower maintenance were Aloyco 20 double-disk gate types, which had already been performing in the sulphuric acid plant since 1953.

The valves are produced by Alloy Steel Products Co., Linden, N.J.

A Formula for Progress In Mineral Industry Education

L. DONOVAN CLARK

DURING THE PAST FIVE YEARS, much has been written about possible deficiencies in minerals industry engineering curricula. E.C.P.D. accreditation standards have become more stringent and regimented, and pressures have been brought to bear upon some thirty U.S. schools to improve their minerals industry engineering curricula by the addition of more and better courses in social sciences and the humanities, and the elimination of courses that are merely descriptive.

Minerals industry educators have been cautious, if not downright resistant, to making sudden and drastic changes under these forces. In some cases, because of lack of facilities, changes cannot readily be made. It is always difficult to give up old practices, which have been good and may still be good at least in part, yet the trend dictates that change must come.

Shortage to Surplus

Twenty years ago, the industry complained of a shortage of mining engineers. Mining and petroleum geologists were in great demand. The quality of their training was, perhaps, not too important to their employers. Could they read and write, run a transit, cut an honest sample, know a few rocks and minerals, or recognize oil froth in the mud? If so, they had a job. Many succeeded admirably, and reached the higher echelons of the organizations they joined. These are the men who now find present mining engineering curricula somewhat wanting, and they are being called upon to give opinions and advice concerning changes.

Those who criticize the present curricula and cry for a broadening of mining engineering courses are the men who have fanned the winds of change by the excellence of their integrity, ability, drive and enthusiasm in the performance of their duties.

They have found it necessary, for instance, to "grow up" with labor, and spend as much as 40% of their time in the entanglements of their relationship with it. This has promoted the desire for a greater understanding of labor problems—something that perhaps was never part of their own curricula. They are now faced with the problems of extracting low grade materials by open pit mining, block caving, waterflooding 9%-porosity rock or pumping oil from depths surpassing 20,000 feet. Their thinking has had to change. Little wonder that they may feel the current minerals industry engineering curricula needs reevaluation. They want to see men trained as they may not have been in research, labor problems, the economics of collective bargaining, business administration, etc., as applied to the minerals industry. They recognize a need for communications skills, including foreign languages and public speaking. They should know, for they feel their own shortcomings, even though they are the ablest of supervisors and administrators.

Low Enrollment a Problem

It is little wonder that minerals engineering educators reel slightly before the task. With E.C.P.D. on the one hand and low enrollment on the other, with industry calling for changes and taxpayers frowning upon expansion of facilities and higher salaries for teachers, the educators must somehow devise a curriculum which will provide companies with the quality of man they need, and, at the same time, maintain an atmosphere in the minerals industry that will attract men to it.

Training programs in industry further complicate matters. Thus it is difficult to know whether to expand academic training in certain fields of engineering specialization, for instance, or drop them out and leave them to industry.

Yet out of this dilemma improvement will come, slowly but surely. That the whole field is being examined by educators and industry alike is a good sign. There is bound to be groping with trial and error approaches, but the answer lies within the responsibilities of both those who teach the minerals industry engineer and those who employ him.

With the strong conviction that the industry wants to encourage petroleum, mining and geological engineering as a profession, the University of Wisconsin has spent much time and effort in "reviewing the trends, and planning appropriate curriculum changes" to meet the broadening requirements of the minerals industry. The Mining and Metallurgical Engineering Department of the University of Wisconsin is now confident that the man well trained in the basic and engineering sciences, with a broad background of social sciences and humanities, will have knowledge he needs to serve the industry well. This department of the Engineering College of the University of Wisconsin is also changing its name to the Department of Minerals and Metals Engineering, and feels that this step is in harmony with the changing times.

Accompanying this face lifting, a curriculum has been designed for all freshmen and sophomores planning careers in mineral and metals engineering. These first two years will encompass essential basic studies. Only one course, designed to give students early contact with the basic concepts of minerals and metals engineering principles, is included in these first two years.

The junior year sees the division into metallurgical engineering and minerals engineering. The latter presents options in mining, petroleum and geological engineering. A core curriculum is common to all three. All students are required to study petroleum and mining engineering and mineral processing; all are required to study the same engineering sciences; and all have the same opportunity for recommended studies in foreign language, labor problems, business administration, numerical analysis and the digital computer, etc. The only minor variance in the curriculum appears in the different geology requirements for geological, mining or petroleum engineering.

Industry's Responsibility

This new look is designed toward a more general engineering science degree with a minimum of specialization in any particular branch of the minerals industry, leaving specialization to the graduate program. Such a four year course of study is believed to be readily complemented by the expanding training programs of industry as, for example, the excellent one at Kennecott for all new engineer employees, handled by their Industrial Engineering Division, the outstanding eighteen month program of Shell Oil Co., and the splendid cooperative graduate training program recently announced by Anaconda.

It is to be hoped that industry will do its part in public relations to convince the young engineering aspirant that a career in the minerals industry is a worthy one, for it is the desire of education to promote this interest and to educate well for the industry so that it will obtain the high calibre of talent from which to choose the industry leaders of the future.

STAFF MEMBERS of St. Lawrence Columbium and Metals Corp. (left to right) are J. A. Roland Faucher, ore dressing engineer; Paul E. Riverin, vice-president; Hector Monette, mine manager; Jean-J. Gourd, president; and Come Carbonneau, geologist and consultant. The new plant in rear includes a crushing plant, filtration plant, ore-bin and the main building housing grinding, gravity separation equipment and columbium and pyrite flotation circuits.

St. Lawrence Columbium Project Starts Production in Quebec

NORTH AMERICA'S FIRST PRODUCER of high-grade columbium-bearing pyrochlore concentrates, the St. Lawrence Columbium & Metals Co., in the Oka district 20 miles west of Montreal, Quebec, started production late in August. Ore from the company's open-pit mine went to the new 500-ton concentrator where metallurgists tuned-up the equipment flowsheet for production of pyrochlore concentrates running minimum 50% Cb_2O_5, and other by-products of economic value.

As reported in E&MJ's earlier article, October 1960, ore reserves are estimated at 62.6-million tons of 0.4% Cb_2O_5 to a depth of 500 ft. on three blocks controlled by the company. Of this total, 17-million tons of proven ore lie in the "A" block now being mined by open-pit methods. Cb_2O_5 content in the "A" orebody is approximately 10 lb per ton.

In market circles, the development of the St. Lawrence project is significant. North America has badly needed an assured source of columbium ores amenable to economic mineral extraction processes. The St. Lawrence holdings contain these reserves, and of greater significance, the company is situated in Canada, a country of demonstrated political stability. With assured supplies of columbium concentrates in sight, it is expected that major metal companies will be stimulated to accelerate programs to develop new markets for the metal and its alloys.

What Is Pyrochlore?

References to pyrochlore are sparse in mineralogy texts. It is a close cousin to microlite which crystallizes in the cubic system. According to Kraus, Hunt, and Ramsdell,[1] the formula for microlite is $(Ca,Na)_2\ Ta_2O_6\ (O,OH,F)$; the formula for pyrochlore is $(Na, Ca)_2\ Cb_2O_5F$. Some pyrochlore minerals contain up to 15% U_3O_8, hence the stimulated interest in this mineral in the recent search for atomic minerals.[2] Specific gravity of pyrochlore is 5-6; hardness 4-6; luster, glassy or resinous; fracture conchoidal; streak colorless to pale yellow or brownish; crystal system, cubic.

The pyrochlore at St. Lawrence Colubium is very low in tantalum—Cb:Ta ratio is 100 to 200:1. It is discernible as small reddish brown cubic or octahedral crystalline clusters in broken ore currently being mined.

The pyrochlore-microlite family of minerals is often associated with pegmatites. Extensive pyrochlore deposits in Africa are also associated with carbonatites and alkalic rocks as they are on the St. Lawrence Columbium property.

Formula for St. Lawrence pyrochlore is $(Na, Fe\ Ce)_{0.8}\ Ca\ (Cb_{1.6}\ Ti_{0.4})\ O_6\ (F, OH)_{1.2}$

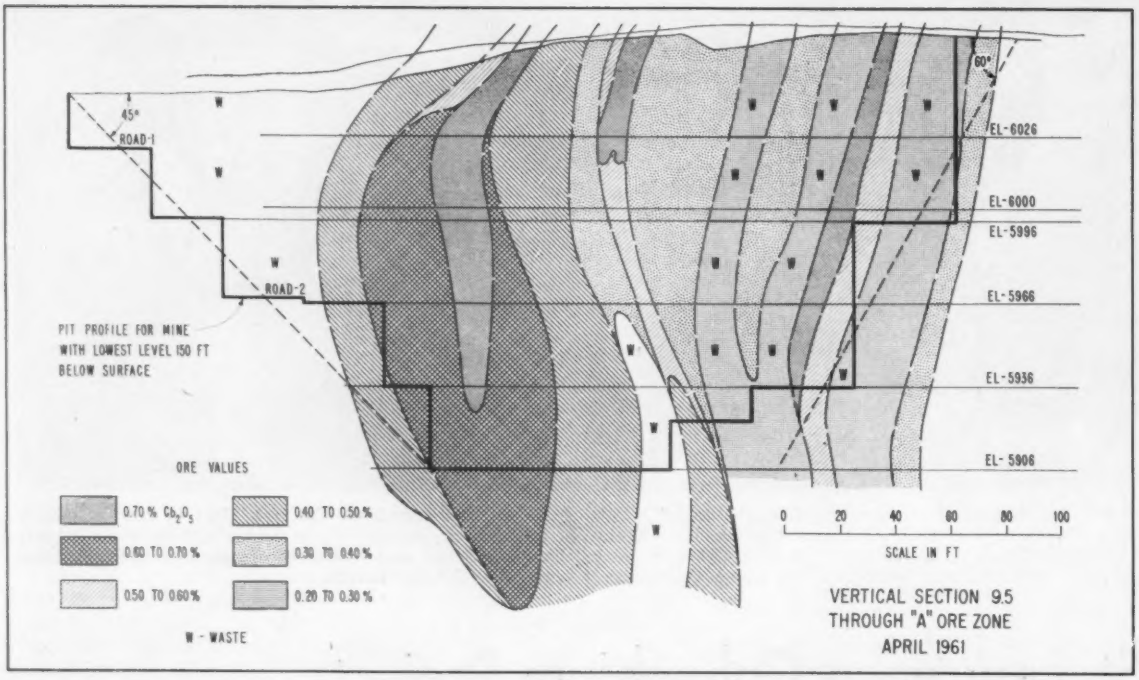
Geology of the Deposit

The geology of the deposits is described by the company as follows: "The columbium deposits of the Oka area occur in a complex of carbonate and alkaline rocks, which cut through Precambrian rocks of the Grenville series. These Precambrian rocks lie along a structural high (the Beauharnois axis), and are overlain by Paleozoic rocks of the St. Lawrence lowlands.

"The Oka complex has a maximum width of about one and a half miles, and extends northwesterly for four miles, in a direction that is at right angles to the general trend of the foliation and the diabase dikes in the Precambrian rocks. The complex is made of a complicated mixture of carbonate rocks and alkaline rocks of various types. The carbonate rocks similar to the Grenville limestones are

The geology and early development of the St. Lawrence Columbium and Metals Corp. project was described in "Quebec's Columbium Will Be Tapped," E&MJ, October 1960.

1 Kraus, Hunt and Ramsdell, "Mineralogy," McGraw-Hill, 1959.
2 Nininger, "Minerals for Atomic Energy," D. Van Nostrand Co., Inc., 1954.



PIT PROFILE has been planned to a 150-ft depth on the "A" orebody to hold waste removal to a minimum. About 17-million tons of ore, running approximately 10 lb of columbium oxide per ton, have been blocked out in the "A" orebody.

MINING WILL START on a 500-tpd basis. Mill capacity can be expanded readily to 750 tpd when demand for pyrochlore concentrates picks up.

banded, and at several places the banding is roughly parallel to the contacts of the Oka complex with the Precambrian rocks. A great diversity of alkaline rocks, not yet fully described, cut through the carbonate rocks as bodies of various shapes, or lie as lenses parallel to the foliation in the carbonate rocks; they are all unusual in composition, but include mainly rocks of the ijolite series, rocks of the jacupirangite series, and lamprophyric rocks. There is no doubt that carbonate rocks were mobilized and flowed after the intrusion of the alkaline rocks. Geologists familiar with the African carbonatites generally do not hesitate to consider the carbonate rocks of Oka as of magmatic origin. The structure in the central part of the complex is poorly or incompletely known, owing to the scarcity of exposures and the near absence of drill holes."

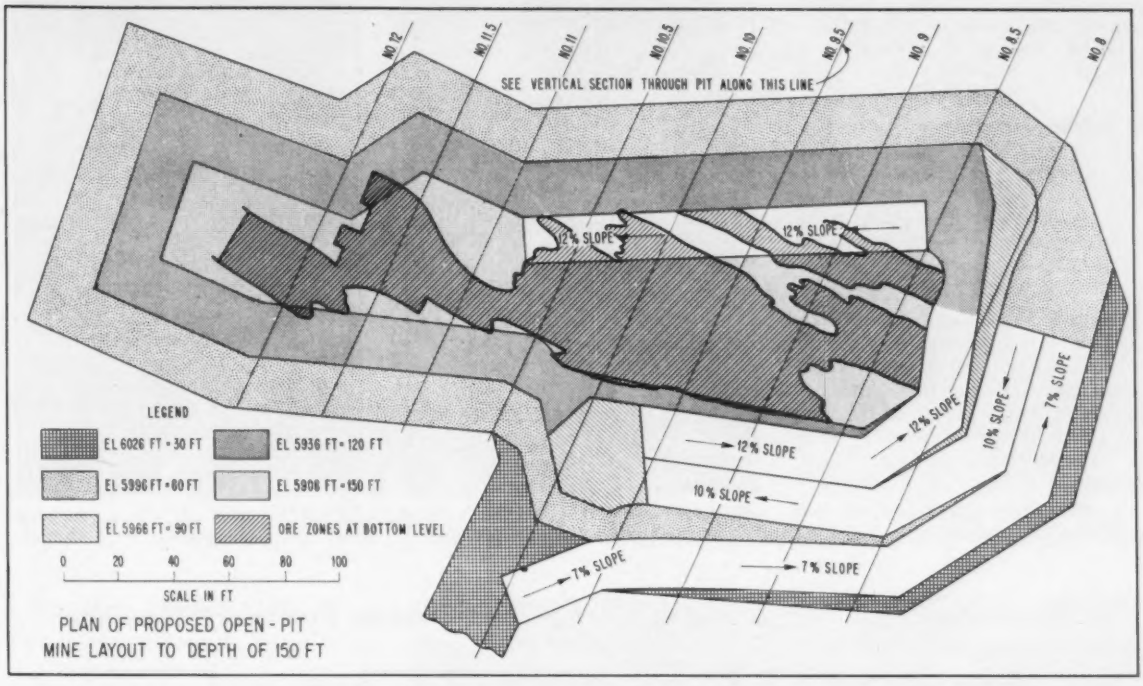
Planning the Pit

Initial plans have been made to mine the "A" orebody by open-pit methods to a depth of 150 ft, as shown in the accompanying plan and section. Bench height will be 30 ft. To achieve a low waste-to-ore ratio, haulage ramps will be developed more extensively on one side of the pit, and benches on the opposite will exceed the 30-ft height during later stages of mining. Because of the inter-mixture of ore and waste in parts of the pit, close supervision will be required to maintain grade of mill feed. The accompanying table indicates the ore-waste ratio and the grade of ore that can be maintained by selective mining.

Overburden is not a serious problem. It can be stripped with loader and truck, or by backhoe where the rock surface undulates excessively. The ore drills and blasts readily (bit life is 4000 ft) because of the high percentage of calcite present.

Mine Equipment

Equipment now in use, or to be acquired shortly includes:



PLAN OF ROADWAYS for the new open-pit mine on the "A" orebody to a depth of 150 ft. Earthmoving equipment includes a 2½-cu yd tractor-type front-end loader and 12-ton trucks. Holes are drilled with 3-in. tungsten-carbide bits.

ST-LAWRENCE COLUMBIUM & METALS CORP.
WASTE-ORE TONNAGE TABLE – ZONE "A"

Section No.		No. 1			No. 2			No. 3			No. 4			No. 5		
		Waste	–	Ore	Waste	–	Ore	Waste	–	Ore	Waste	–	Ore	Waste	–	Ore
8.5	a)	19,200	–	31,720 0.50	15,180	–	33,120 0.51	11,140	–	25,160 0.51	8,380	–	22,520 0.45	3,180	–	14,600 0.45
	b)	19,200	–	31,720 0.50	15,180	–	33,120 0.51	11,140	–	25,160 0.51	13,740	–	17,160 0.52	8,940	–	8,840 0.58
9.0	a)	19,160	–	24,080 0.50	21,040	–	24,240 0.51	15,180	–	19,880 0.56	10,680	–	18,260 0.58	1,040	–	15,380 0.58
	b)	23,900	–	19,340 0.55	26,100	–	19,180 0.57	18,120	–	16,940 0.60	10,680	–	18,260 0.58	1,040	–	15,380 0.58
9.5		18,300	–	26,300 0.50	18,740	–	29,580 0.50	10,000	–	25,560 0.52	6,200	–	20,000 0.57	2,380	–	13,080 0.57
10.0		18,720	–	20,480 0.54	19,800	–	22,460 0.59	9,300	–	23,640 0.53	6,080	–	17,980 0.49	1,200	–	12,840 0.48
10.5		12,140	–	14,080 0.54	17,160	–	15,480 0.58	7,460	–	15,700 0.52	8,180	–	14,760 0.48	2,040	–	9,740 0.49
11.0		23,900	–	7,400 0.58	26,580	–	4,740 0.65	17,460	–	4,080 0.62	18,420	–	3,880 0.59	7,760	–	3,720 0.57
11.5		12,620	–	12,060 0.59	18,820	–	15,180 0.57	8,780	–	14,740 0.56	8,420	–	15,680 0.56	2,540	–	10,940 0.63
12.0		19,080	–	4,340 0.60	28,420	–	5,320 0.85	13,180	–	6,040 0.90	13,000	–	6,220 0.90	2,940	–	6,260 0.90
		143,180	–	140,460 0.53	165,740	–	150,120 0.55	92,500	–	134,800 0.55	79,360	–	119,500 0.54	23,080	–	86,560 0.56

GRAND TOTAL = Waste : 503,860 ton = 44.38 %
Ore : 631,440 ton (a) 0.545 = 55.62 %
100.00 %

Note: Sections 8.5b and 9.0b are not included in the total tonnage.

ORE AND WASTE moved during first two months of operation of the pit.

Compressor: 1000 cfm, XVHE, Canadian Ingersoll-Rand, delivering compressed air through a 3-inch aluminum pipeline to pit.

Drilling: PR-123, Gardner-Denver Air Track drill; 3-in. tungsten-carbide bits; rods, 1½-in.x10 ft equipped with Hi-Leed threads.

Loading: Special 2½-cu yd, track-type, Eimco front-end loader similar to design developed for Noranda's Gaspe Copper operations.

Haulage: Three 12-ton trucks.

Pit drainage: Bibo, Flygt pumps. Operating statistics reported by

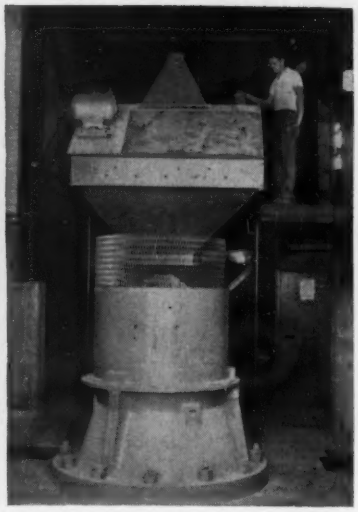
Claude Bourgouin, mine superintendent, for the mining of 27,000 tons of ore and waste during July and August 1961 are as follows:

Drilling: Spacing and burden for 3-in. holes, 7x8 ft; depth, 20 to 30 ft; labor cost per ton, 2½c; drilling speed average, 2 fpm; bit life, 4000 ft; abor cost per ton, 2½c; drilling supplies cost per ton, 2c; footage drilled, 4500.

Blasting: Explosives used consisted of 30% dynamite, and 70% mixture of ammonium nitrate and fuel oil; detonators; short-period electrical blasting caps, No. 0 to No. 8 with 30 ft wires; powder factor 0.45 to 0.75 lb per cu yd.

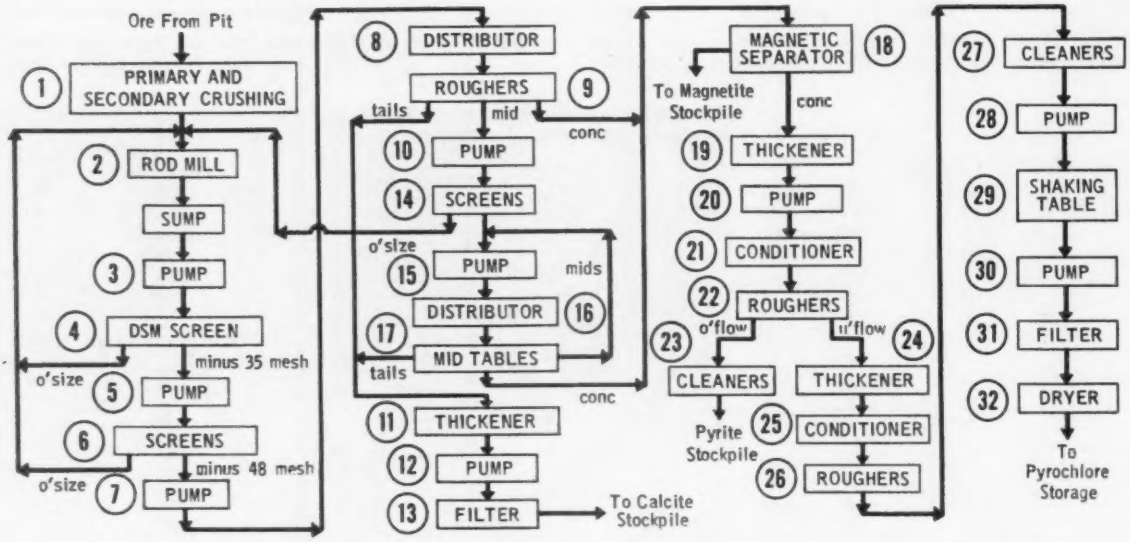
Loading, hauling and dumping were performed by contractors.

PRIMARY JAW CRUSHER is large enough to crush 125 tons per hour.



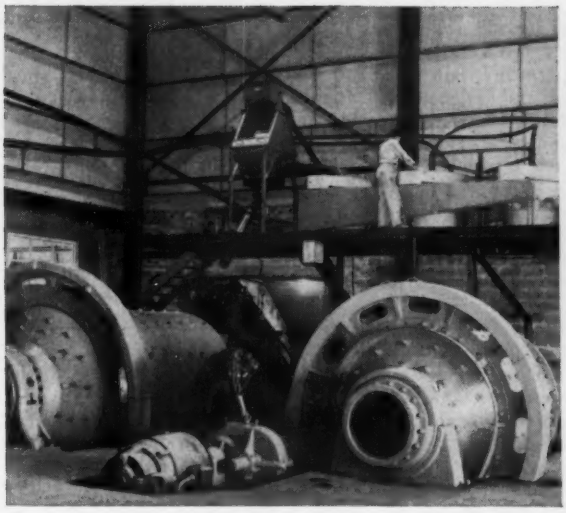
OVERSIZE from Nordberg scalping screen goes to secondary cone crusher.

St. Lawrence Columbium & Metals Corp., Oka, Quebec Pyrochlore Flowsheet

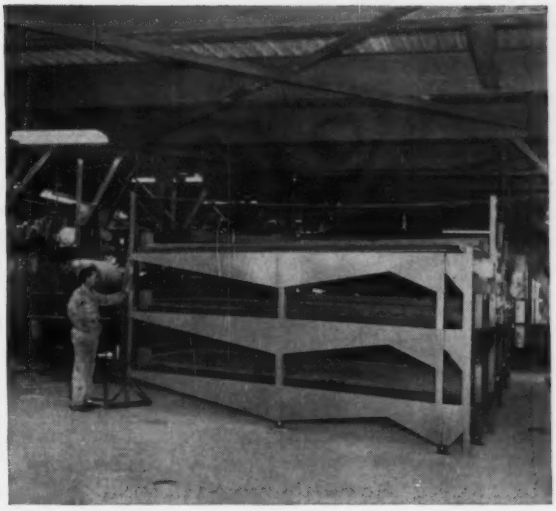


LEGEND

1. Primary and secondary crushing takes ore from the pit down to minus ¾-in.
2. 7x10-ft Hardinge rod mill, 150 hp motor
3. Linatex 5-in. pump
4. Dutch State Mines 24-in. screening unit
5. Linatex 5-in. pump
6. Southwestern Engineering Co. 48-in. screens, "Kason"
7. Linatex 5-in. pump
8. 21-way Denver Equipment Co. distributor
9. Seven 3-deck Deister "Concenco 666" tables
10. Linatex 3-in. pump
11. Rougher tails to a 47x16-ft thickener in the tailings filtration plant
12. Linatex 5-in. pump
13. Thickener underflow goes to an Eimco 8-disk filter, 8½-ft dia, which delivers the dewatered calcite tails to stockpile
14. Sweco 48-in. screens
15. Linatex 3-in. pump
16. 6-way Denver distributor takes middlings from the rougher section
17. Two triple-deck Deister tables
18. Humboldt 24x36-in. magnetic separator
19. 7-ft Denver thickener
20. Linatex 2-in. pump
21. 4-ft Denver conditioners head the pyrite circuit
22. Three Galigher No. 24 Agitair rougher cells
23. Two Denver No. 15 cleaner cells. Underflow returns to pump (No. 10) in front of second distributor
24. 7-ft Denver thickener
25. Two 4-ft Denver conditioners
26. Three Galigher No. 15 Agitair units. Underflow from first unit returns to Hardinge mill (No. 2) in front of flowsheet, underflow from other two returns to the thickener at the head of their own circuit (No.24)
27. Two Denver No. 15 cleaning cells
28. Galigher 1½-in. pump
29. One Deister No. 14 shaking table
30. Denver 1-in. pump
31. Dorr Oliver 12-in. drum filter, with Roots-Connersville vacuum pump
32. General American Transportation 2x10-ft oil-fired drying kiln



FINE ORE, crushed to ¾-in., is ground in Hardinge mills and sized by Dutch State screen in series with Sweco screens.



TRIPLE-DECK CONCENCO 666 tables produce a gravity concentrate, calcite tailing, and mids which go to tables.

The New Surface Plant

Five units comprise the surface plant:

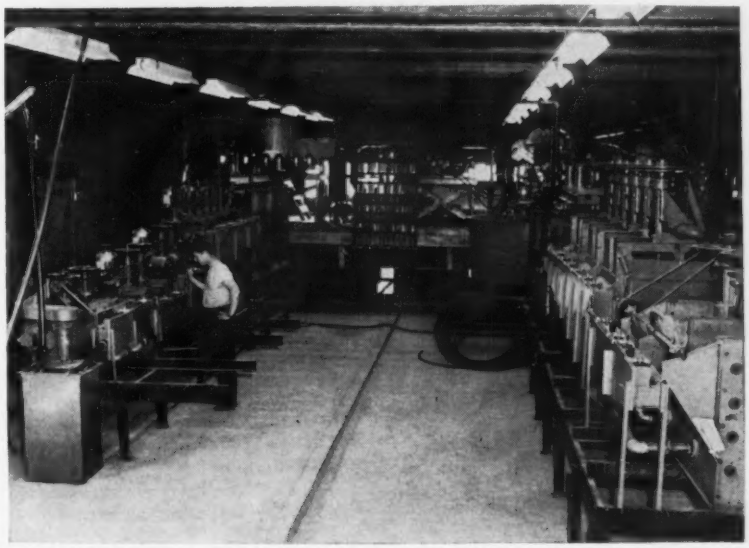
1. A two story building, 152x87-ft, housing the concentrator, offices, chemical laboratory, garage, warehouse and the mechanical-electrical shop.

2. Crushing plant with intentionally high-rated capacity of 125 tph.

3. Storage bin integrated in an 80x32-ft building with live capacity of 2200 tons.

4. Tailings filtration plant, designed to dewater and stockpile comparatively dry solids consisting chiefly of calcite. This plant performs the triple duty of preventing stream pollution in the agricultural lands that surround the St. Lawrence property, impounding nearly-dry tailings in a dammed-up area, and returning water to the mill for processing.

5. Water supply. Plant water is supplied by artesian wells. The first has been sunk in an altered zone near the concentrator. The 12-in. hole, 300 ft deep, contains a deep-well pump installed 200 ft below the collar of the hole, and powered by a 50-hp motor. The stand-by water source connected to the mill by a 3000 ft, 6-in. pipeline consists of a second artesian well and a storage pond with capacity exceeding 1-million gal.



FLOTATION SECTION includes pyrite flotation at right, pyrochlore section at left, and filtering and drying units in rear. Rougher and cleaner cells are Galigher Agitair cells, and terminal cells are Denvers installed to avoid pumping.

Mill Highlights

The new mill, with initial capacity of 500 tpd, is designed so the capacity can be expanded readily to 750 tpd when demand materializes. The crushing plant, with ample capacity of 125 tons per hour, will handle expanded capacity, and the crushing of waste material which will be of value as an aggregate or fill due to the close proximity of the St. Lawrence Columbium property to construction projects in Montreal's expanding suburban areas.

A storage bin with live load of 2200 tons is housed in a 80x32 ft. structure. Seven drawpoints served by Link-Belt shuttle feeders will enable the mill operators to blend and maintain a uniform grade of feed for the mill.

The accompanying flowsheet contains all essential information on the milling process which was developed through pilot-plant research in the laboratories of l'Ecole Polytechnique, the faculty of applied sciences of the University of Montreal, by the staff of St. Lawrence Columbium & Metals. Galigher Co., of Salt Lake City, served as consultants in designing the pilot plant. The current plant was developed under the direction of Roland Faucher, one of Canada's leading ore dressing specialists, who has broad experience in nonmetallic mineral processing.

The ore crushes readily because of

Analysis of Pyrochlore Concentrate Produced By St. Lawrence Columbium and Metals Corp.

Cb_2O_5	52+		
CeO_2	3.0	to	6.0
Fe_2O_3	2.7	to	5.0
Ta_2O_5	0.09	to	0.5
MnO_2	0.07	to	0.74
Gd_2O_3	0.0	to	0.2
SrO	0.42	to	1.2
U_3O_8	0.05	to	0.20
ThO_2	0.07	to	0.30
ZrO_2	0.80	to	1.3
TiO_2	4.0	to	6.5
F	2.5	to	4.05
CaO	15.0	to	20.0
MgO	0.0	to	2.10
Al_2O_3	0.23	to	0.70
SiO_2	0.2	to	0.6
P_2O_5	0.1	to	0.6
Na_2O	3.3	to	3.70
K_2O	0.20	to	0.80
S	0.1	to	0.4
WO_3	Traces		
SnO_2	Traces		

Sept. 5, 1961.

Average Chemical Analysis of Pyrochlore Coming from the Property of St. Lawrence Columbium and Metals Corp.

Cb_2O_5	60.0 %
Ta_2O_5	0.5
TiO_2	4.5
Fe_2O_3	2.70
Na_2O	3.50
K_2O	0.60
SrO	0.60
CaO	15.08
MgO	1.00
MnO_2	0.37
ZrO_2	1.0
U_3O_8	0.10
ThO_2	0.23
Y_2O_3	0.12
Gd_2O_3	0.2
CeO_2	3.0
La_2O_3	0.7
SiO_2	0.08
F	3.69
H_2O+	1.24
	99.21%

Sept. 5, 1961.

the high calcite content. Approximate mineralogical composition of the ore is as follows:

pyrochlore	1.0%	magnetite	3-4%
calcite	75-80%	mica	3-4%
diopside	6-10%	pyrite	1-2%
apatite	3-4%		

It is expected that already available commercial markets for various by-products will be readily supplied, hence the flowsheet is designed to segregate and stockpile good grades of pyrite, calcite, magnetite, and apatite.

Because the primary concentrating step involves gravity separation, sizing of the feed is particularly important. Fine-ore feed, reduced in the primary and secondary crushing plant to ¾ in. is fed to a 7x10 ft Hardinge rod mill powered by a 150-hp motor. The 48-mesh output of the mill is sized by a Dutch State Screen in series with three Sweco screens which can be used for delicate control of mill feed size when necessary.

Sized product goes to a 21-way Denver distributor which feeds seven three-deck Concenco 666 tables incorporating stroke and tilt regulators which will enable operators to control distributions of table products precisely.

Approximately 60% of the bulk of the mill feed is eliminated by the tables in the form of calcite concentrates. These are pumped to a 47x16 ft thickener in the tailings filtration plant. Underflow goes to a 8½-ft-dia 8-disk Eimco filter which delivers the dewatered calcite tails to stockpile in an area confined by earth dams to prevent any pollution of the streams exiting from the property. Water from the filtration plant is returned to the grinding circuit for re-use.

Table middlings go to two triple-deck middling tables which produce concentrates which join the rougher table concentrates, tailings which join the calcite rougher tailings, and mids which are recirculated to the head of the middling tables.

Table concentrates go over a magnetic drum separator, which removes the magnetite. Remaining concentrates containing the pyrochlore and other heavy minerals then go to a conditioner which feeds a pyrite flotation circuit consisting of Galigher No. 24 rougher cells, and Denver No. 15 cleaner cells. Denver cleaner cells were chosen because of their pumping ability.

Pyrochlore Flotation

Tailings from the pyrite circuit contain essentially pyrochlore contaminated by some apatite, silicates, mica and diopside. The pyrochlore flotation section permits extraction by rougher Agitair Galigher cells, and is flexible to allow as much cleaning and recleaning as may be necessary under various operating conditions to yield a high-grade pyrochlore concentrate. Reagents consist of an amine collector and a catalyzer to stimulate pyrochlore flotation. The pH is maintained at 5 to 6.5, and is not a critical problem. Final pyrochlore concentrates go over a shaking table which enables operators to observe quality of final product, and to upgrade it slightly.

Pyrochlore concentrates then go to a 12-in. Dorr-Oliver drum filter and are dried in a General American Transportation Co. oil-fired drying kiln. Dried concentrates are fed to an eight-compartment storage bin—one compartment for each day's production. Concentrate output for each day is analyzed. Final packaged or bagged concentrates can be blended to maintain high grade of shipped products.

Water Supply

Water for the plant will be supplied by artesian wells. The first well sunk in an altered zone near the concentrator supplies approximately 350 gpm, believed to be ample for mill consumption. The well is 12 in. in dia and 300 ft deep. A 50-hp deepwell pump has been installed at a depth of 200 ft. Some 3000 ft away, a standby water source has been prepared, consisting of another artesian well, a pond with more than 1-million gal capacity, and a 6-in. pipeline to the mill. Fresh water for the mill is fed from a 30x30-ft feed water tank to the tables and flotation section. Reuse water from the 47x16-ft tailings thickener goes to a second feed tank which supplies the grinding section. Since tailings are filtered and delivered as dry as possible to storage areas, the plant will not be a source of stream pollution in the area.

Compressed Air

Compressed air is supplied by a 1000 cfm Canadian Ingersoll-Rand unit powered by a 150-hp synchronous motor. The centralized compressed air source with synchronous motor was selected to improve the plant's power factor, since all other motors are induction motors.

Photo Credit: All photos by David Bier Studios, Montreal, Canada.

Personnel

Jean-Joffre Gourd, president

Paul E. Riverin, vice president

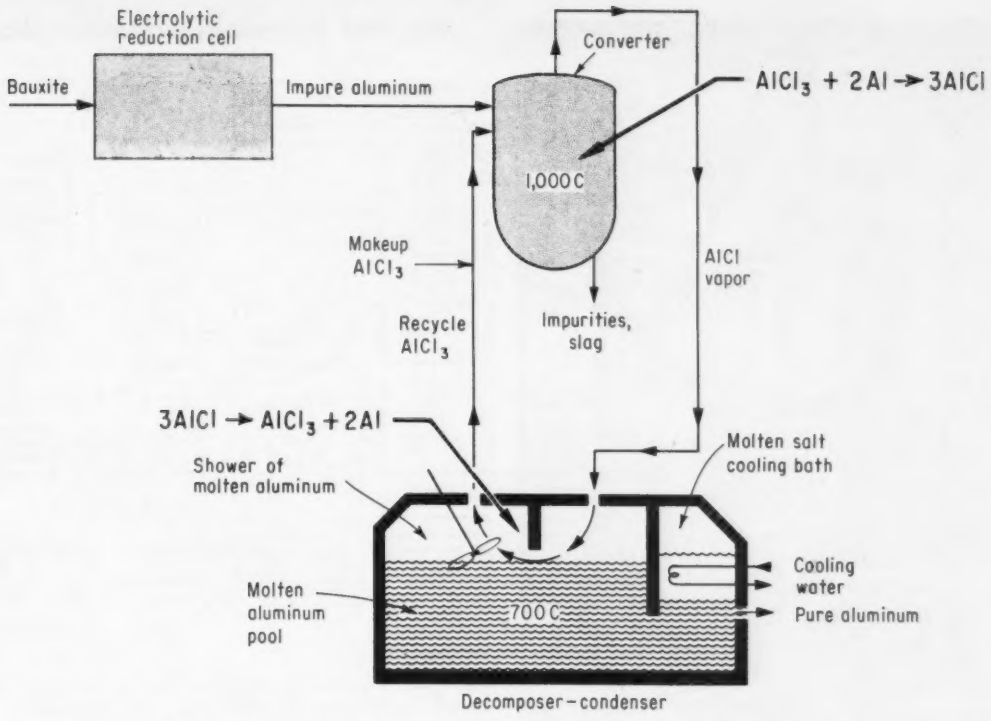
Hector Monette, general manager

Roland Faucher, ore dressing specialist

Claude Bourgouin, mine superintendent

Come Carbonneau, consultant

Perrault Guy, geologist



DURING FINAL stage of Aluminum Ltd.'s direct reduction process, metallic aluminum contacts $AlCl_3$ in the reactor operating at 1000-1200°C. Data from British patent 846,189; flowsheet appeared in Chemical Engineering, Oct. 17, 1960.

New Methods, New Ore Sources Attract Aluminum Industry Research Efforts

Finn B. Domaas

THE ALUMINUM INDUSTRY, despite the recent price reductions, and the fact that idle capacity totals 500,000 tons, could, according to company officials, recover lost ground at any time. Total predicted shipments for 1961 should be 2.45-million lb, 4% above 1960.

Aluminum producers will be more than adequately prepared when the predicted increase in consumption becomes fact. New orebodies are continually being explored and mapped; aluminum is replacing the other metals in more and more applications for industry and government; and, of probably greatest importance, research to develop improved refining techniques is being carried out at a feverish pace.

The individual companies' slim margin of profits and the intense competition for new markets, have forced the aluminum producers to maintain an almost religious policy of "no comment" about laboratory experiments into revolutionary technology. In no major industry is there more an atmosphere of secrecy and watchfulness than that which now permeates aluminum.

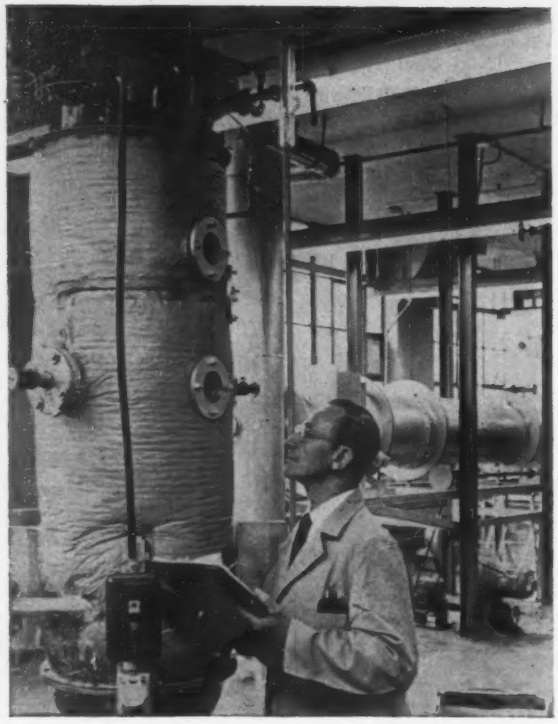
Though most announcements of work done in laboratory and pilot plant are sketchy and incomplete, they often fit into patterns which show clearly what one can expect to see, when one can expect to see it, and just what effect, if any, the development will have on the entire industry.

For the past few years, technological innovations have centered about (1) the direct reduction of aluminum from bauxite, and (2) extracting alumina from raw materials other than bauxite.

When Aluminium Ltd. (Alcan) and Pechiney first announced their separate schemes for the direct reduction of aluminum, industry reaction was immediate and varied. Since the outcome of the initial experiments could have a tremendous effect on the entire industry, and since most of the early critics would lose or gain by the success or failure of direct reduction, many of the arguments were understandably subjective.

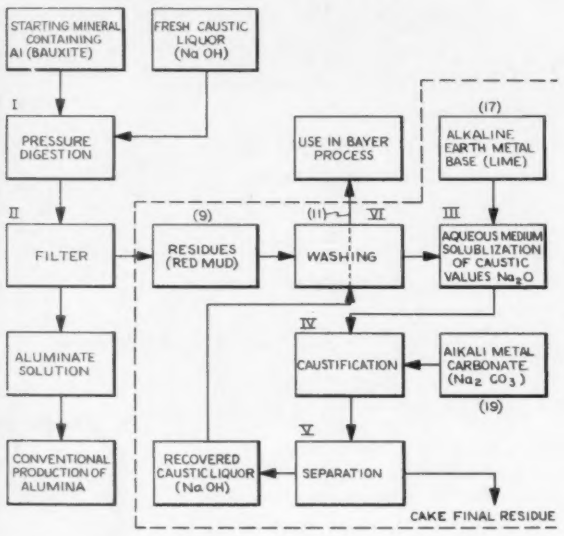
At the present time, the industry reaction to direct reduction is "wait and see". No one seems prepared to dismiss categorically the merits of a process that would eliminate the alumina stage and extract aluminum directly from the raw material. Speculation and doubt do exist, however, as to just how successfully the theory of direct reduction can be applied to large-scale commercial operations.

The questions most asked are: how soon will it be before direct reduction leaves pilot-plant testing and goes into full-scale operation; if the process becomes commercial, can present standard-method installations convert to direct reduction; will the process be able to handle all grades of aluminum ore; and can ores other than bauxite be used?



SECRET of Olin Mathieson's alumina-from-clay process is how to make crystals large enough to extract from iron.

Flowsheet 2: Pechiney's reduction circuit



Most direct reduction questions cannot at this time be answered, even by Aluminium or France's Pechiney. However, Alcan will begin commercial testing at the end of this year or early 1962 at its $4-million plant at Arvida, Que. Company officials say that, if tests are successful, the new process could be expected to reduce capital investment at new plants by at least 50%, and bring savings in operating costs through lower labor, materials and depreciation costs. The company also said that savings resulting from the vapor-condensation process will not come as much from a power reduction as from the elimination of materials—the caustic soda used in great amounts in the present chemical reduction of alumina and the cryolite and electrode materials used in the refining stage.

The Arvida pilot plant will have an annual capacity of 6000 to 8000 tons. How soon Aluminium will begin large-scale production by the new process will depend on just how it works at Arvida during a year's run.

The closely-guarded secret of direct reduction is the process itself. An idea of Aluminium's efforts may be obtained from British patent 846,189 in which Aluminium Laboratories Ltd., the company's wholly-owned research and engineering subsidiary, outlined the last half of the process. The main point here is that, instead of separating impurities in the alumina-extraction plant, Aluminium reduces Al_2O_3 to metal in the presence of all the impurities in the ore, then distills out the metal.

Nothing is said of how the bauxite is reduced, but once the aluminum is in the metallic state, the reduced mass contacts $AlCl_3$ in the reactor operating at about 1000-1200°C and 1 atm. Under these conditions, the volatile monohalide, AlCl, forms and flows to a condenser, leaving impurities behind in the converter.

The condenser is a refractory-lined vessel containing a large pool of molten aluminum at 700-800°C. A partially submerged impeller throws up a continuous shower of molten metal, which cools the incoming monohalide. At the lower temperature the first reaction reverses, forming metallic aluminum and $AlCl_3$, which is recycled.

A body of molten salt (200-400°C), which floats on top of the aluminum, is maintained in another compartment to absorb heat from the aluminum bath. Cooling coils running through the salt bath take the heat out of the condenser.

This two-stage heat removing system, which Alcan calls a key to the process, is an improvement over previous splash condenser designs which have tried to use cooling coils submerged directly in the molten aluminum. Steel piping with strength enough to withstand the high temperatures have usually dissolved in the aluminum.

The patent stated that equilibrium mixtures of sodium chloride and aluminum trichloride form a convenient cooling medium to absorb heat from the molten aluminum bath, and, under prescribed conditions of temperature and pressure, the mixed salt bath stays molten at a relatively low temperature. It has a low vapor pressure and is less dense than aluminum so that the salt floats on top of the pool.

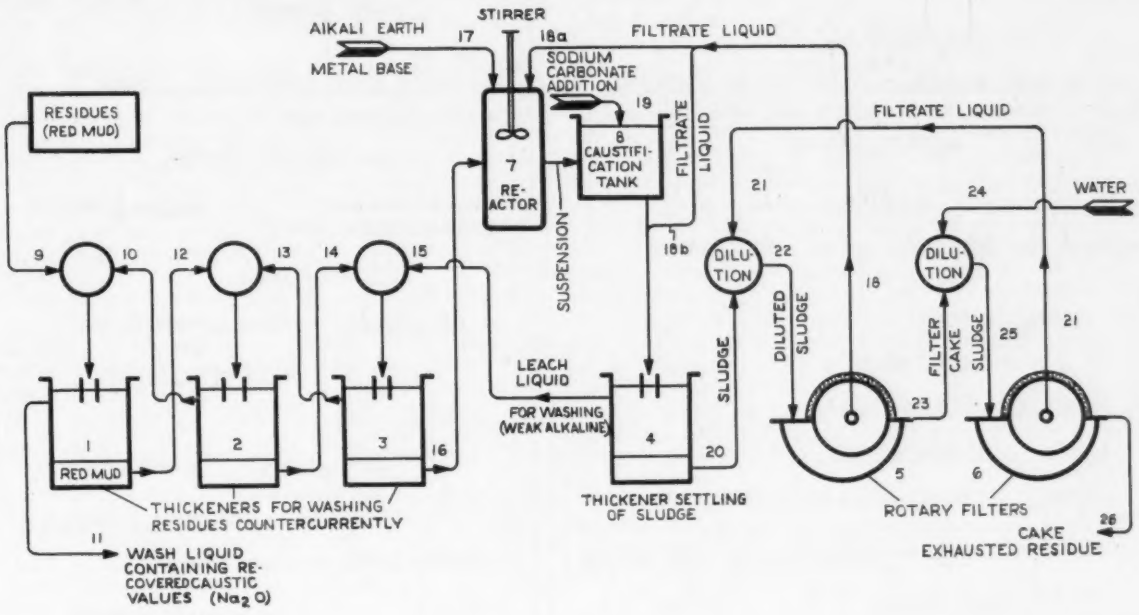
The second research program, developing processes which will extract alumina from materials other than bauxite, is one in which a larger number of producers have taken an active part. In the laboratories, clays, phosphates and shales have been roasted, dried, and rearranged in any one of a number of ways to break them down into workable component parts.

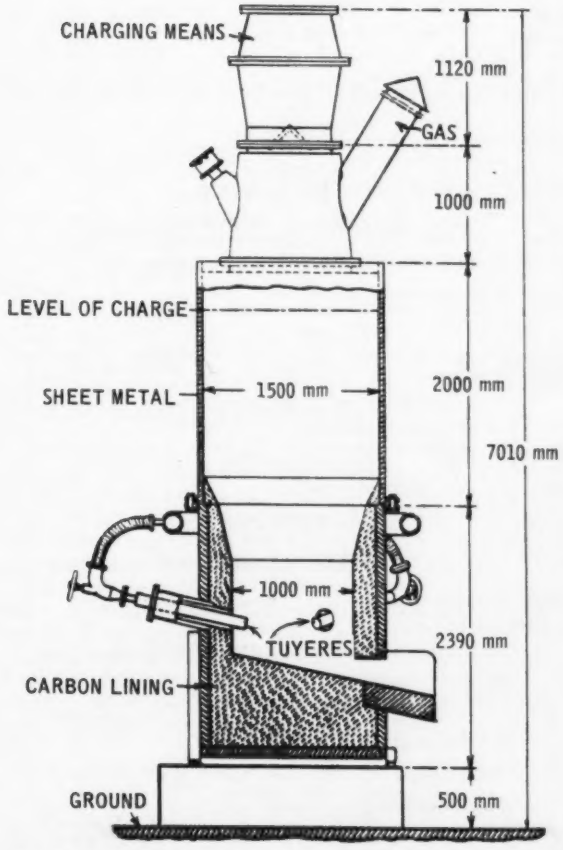
Olin Mathieson Chemical Corp. has piloted an economical process for producing high-quality aluminum sulphate from domestic clay or waste coal-mine shale. The company now expects to pilot-test several ways to thermally decompose this aluminum sulphate to alumina and recover sulphur trioxide. When this second part of the Olin program is developed, the company will be able to produce aluminum from clay containing 20% alumina, rather than from bauxite containing 45-60% alumina.

The general processing scheme, then, is to: (1) leach the low alumina-content clays or shales with sulphuric acid to put the aluminum, and some iron, into solution; (2) separate the iron and aluminum sulphate by means of crystallization from the solution; and (3) processing the resulting aluminum sulphate crystals into alumina and recovering the sulphuric acid for recycling into the first process step.

Though other firms have pilot-tested the first stage—

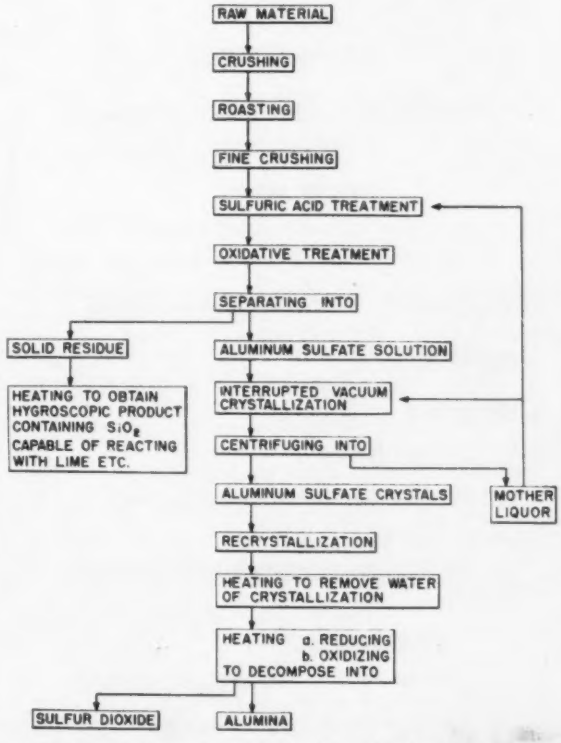
extracts alumina from bauxite and other silica-rich ores.





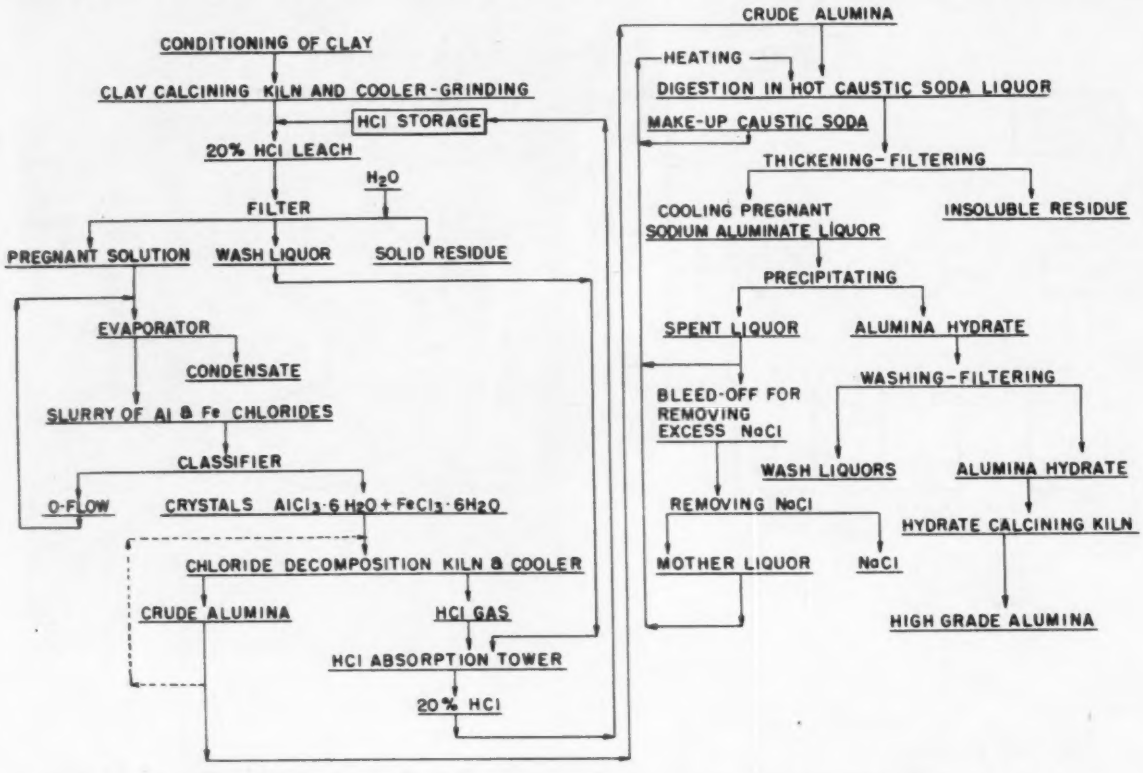
IN PECHINEY'S low-stack furnace, blast is controlled so that all material passes through 1750-1850°C zone.

Flowsheet 3: Improved Reduction of Alumina

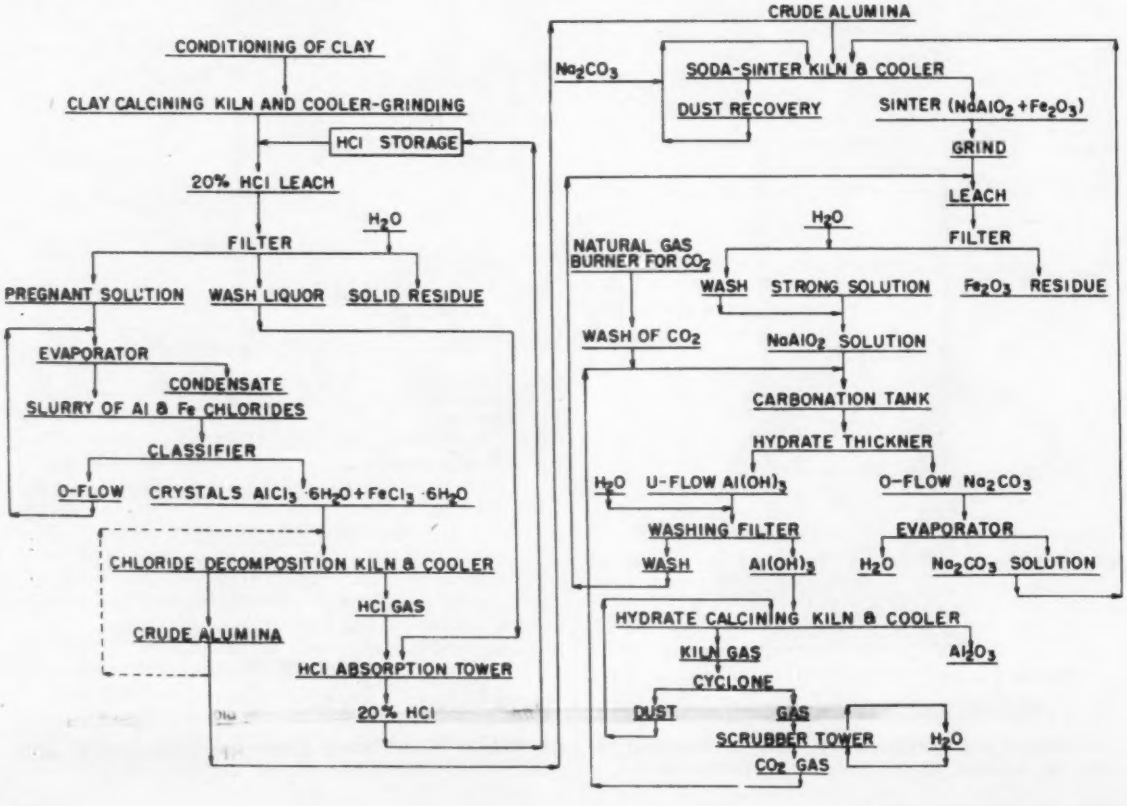


HERMANN Kretzschmar's alumina reduction scheme produces no wastes—sulphur dioxide becomes sulphuric acid.

Flowsheet 4: Second Stage of Anaconda Clay Process Has Crude Alumina Treated by Caustic Soda



Flowsheet 5: Second Stage of Alternate Anaconda Process Treats Crude Alumina With Soda-Sinter



leaching the clays or shales with sulphuric acid—the aluminum sulphate crystals thus produced have been tiny (0.01 in. dia), mushy, and difficult to separate from the slurry.

The heart of the Olin process, and that which still remains a closely-guarded secret, is the manufacture of large crystals which can be more easily separated from the iron.

Walter C. Saeman, senior research associate in Olin's metallurgical laboratories, was responsible for the development of the large crystals. Since the crystallization was controlled, Saeman was able to obtain an aluminum sulphate of very high purity. Not only was the purity of the sulphate high but, according to Olin, the percent recovery of the aluminum was excellent.

Saeman's crystals have paved the way for the third step in the process—decomposing the aluminum sulphate to alumina and recovering the sulphur trioxide—and the several schemes for this thermal decomposition are what Olin will now pilot test.

Anaconda also Researching Alumina-from-Clay

Another method for extracting alumina from clay, developed by The Anaconda Co., is outlined in U.S. patent 2,947,604, issued to Frederick Laist on Aug. 2, 1960. Laist's process is an improved method of producing a high grade alumina, substantially free of silica and iron, from clays containing varying amounts of both materials.

The process contains two stages of treatment; the first, in which silica is removed from the clay and a crude alumina containing ferric oxide is produced; and the second step, in which the ferric oxide is eliminated and a high-grade alumina produced.

During the first stage of treatment, and after the clay has been calcined, it is leached by a 20% solution of hydrochloric acid to place the aluminum and iron compounds as chlorides in solution and leave practically all of the silica in the insoluble leach residue. After filtration, the solution of aluminum and iron chlorides is concentrated by evaporation to produce a crystal slurry. This slurry is roasted and the chlorides are decomposed into oxides, giving off hydrochloric acid gas which is recovered for reuse in the first stage treatment. What remains is a silica-free crude alumina containing about 15% ferric oxide.

The second stage treatment to remove the iron can be carried out either by caustic soda digestion treatment (Flowsheet 4) or by the soda-sinter treatment (Flowsheet 5). The choice of treatments depends on the amount of silica and iron left in the crude alumina. Though a small amount of silica would be tolerated in the caustic soda digestion treatment, it would be dissolved during the soda-sinter treatment, causing the final alumina product to be contaminated. If the iron of the first stage alumina is low, (not more than 6%), the caustic soda treatment would be the better of the two; if the iron content is high, Laist recommends the soda-sinter treatment.

The objective of both purification treatments is to place the crude's alumina content in solution while not altering the iron. The insoluble iron oxide residue is then separated from the sodium aluminate solution. After this, the solution is heated to precipitate aluminum hydroxide which, when roasted, produces a silica- and iron-free alumina suitable as feed to the pot line of an electrolytic aluminum reduction plant.

The United States aluminum industry presently obtains more than 80% of its bauxite from overseas sources, including Jamaica, Surinam, the Dominican Republic, Haiti and British Guiana. None of the major U.S. producers feels that for any reason, including political, will there be any danger of that bauxite not being made available for many years to come. Why, then, consider alumina from clay? Why spend the millions of dollars necessary to perfect the extraction of alumina from sources other than bauxite? Perhaps as clear as any answer to the question was one given earlier this year at the dedication of Olin Mathieson's New Haven research center.

Speaking for his company's operations, but expressing the views of the industry, Olin vice president for research, Dr. W. E. Hanford, said "with this key step (clay-shale processing), it should be possible to produce aluminum where cheap power exists, without having to compromise on plant location to suit both the raw material and the power source." Most alumina plants, he continued, have been located on deep water ports to reduce the cost of bringing in ore from the tropical "bauxite belt." The Olin process opens the possibility of placing a complete aluminum plant on one site where coal for electric power is cheap, since the shales associated with most coal (and left as waste material) could be an excellent source of alumina, Dr. Hanford said.

Work is continuously being done by, and patents continually issued to, individuals and companies that are modifying, adding to, and revolutionizing aluminum processes and equipment.

Canadian patent 596,598, issued to Pechiney, Compagnie de Produits Chimiques et Electrometallurgiques, on April 19, 1960, describes the manufacture of alumina in a low-stack blast furnace.

According to the patent, the Bayer process, which treats bauxite with an alkaline solution that generally contains soda, "is ill-adapted for excessively siliceous bauxites because it leads to too large losses of soda and alumina."

One method of handling siliceous bauxite would be to take suitable amounts of silica-rich bauxite, carbon and iron pyrites and treat them in a furnace. This would produce slag containing 80% oxide and 20% sulphide, which is fluid at about 550°C lower than the melting point of alumina. The iron in the original bauxite could be tapped off, and with it would go most of the other metallic impurities. The slag is then treated with water or dilute acid to hydrolize the sulphide to produce amorphous alumina; alumina in the form of corundum.

Results of the completed process are: (1) recovery of the major portion of the sulphur in the aluminum sulphide by a presulphurization of the crude bauxite; and (2) leaching out most of the impurities still remaining in the original slag.

Low-Stack Furnace Reduces Power Need

Pechney developed their low-stack blast furnace to overcome the most serious process drawback, the need for tremendous reserves of electric power. An important feature of the low-stack unit is controlling the blast in such a way that all of the charge components pass through a 1750- to 1850°C temperature zone, the hottest portion of which is above the tuyeres and about midway between them. The aluminum sulphide and aluminum oxide slag forms in the 1750-1850°C zone, passes the superheated area at the tuyere level, and then passes into the furnace's lower zone, where it separates from the ferro-silicon and can be tapped.

Hermann Kretzschmar of Vereinigte Aluminium-Werke Aktiengesellschaft, Bonn, Germany, was awarded U.S. patent 2,951,743 (Sept. 6, 1960) for a process which produces alumina without leaving waste materials. (Flowsheet 3). According to the patent, a raw material containing silicic acid and alumina is decomposed by sulphuric acid to form an aluminum sulphate solution and solid silicic-acid residue. The solution is then treated to obtain aluminum sulphate crystals which are then heated and decomposed into sulphur oxides and alumina. The high-purity alumina can then be reduced to aluminum—dioxides become sulphuric acid.

Commercial Recovery of Vanadium By the Liquid Ion Exchange Process

R. R. SWANSON, H. N. DUNNING and J. E. HOUSE

RECOVERY OF VANADIUM by liquid ion exchange has been performed commercially for several years. Much of the preliminary research was conducted by government agencies[1, 2]. Early recovery was accomplished with cationic extractants, such as organophosphoric acid compounds,[3] and with a combination of organophosphoric acid and a tertiary amine, Alamine® 336[4]. This latter combination was developed specifically for liquors produced by leaching salt-roasted ores with sulphuric acid.

Until recently, liquid ion exchange methods for concentrating and purifying vanadium were limited to acidic systems since only the protonated forms of the amines will extract anions, and organophosphoric acids form inactive sodium salts in basic solutions.

A LIX® reagent capable of extracting metallic anions from both acidic and alkaline media has been developed. This reagent is a high molecular weight, water-insoluble quaternary ammonium chloride, Aliquat® 336; its application has been studied extensively in this laboratory and by the Colorado School of Mines Research Foundation.

Essentially, the liquid ion exchange process illustrated in Fig. 1, is a double counter-current extraction. In the first operation, the metallic anion (from aqueous solution) combines with the fatty quaternary (in an organic diluent) to form a complex that is soluble in the organic diluent. This loaded organic solution then is contacted with a suitable aqueous stripping solution to release the metallic anion from the quaternary and convert the quaternary to a form suitable for recycle and further extraction. The specificity of the process, therefore, depends upon both the extraction and stripping properties of the LIX reagent.

Extractions were conducted in batch operations to determine preliminary and equilibrium data. These operations were conducted at various organic:aqueous volume ratios, at room temperature, with a 60 second contact time. Operational variables were studies in multi-stage laboratory-scale continuous extractors.

For use in chloride alkaline systems, the quaternary was converted from the chloride to the sulphate form prior to its use as an extractant. Instructions for this conversion, and conversion to other forms, have been reported previously[5].

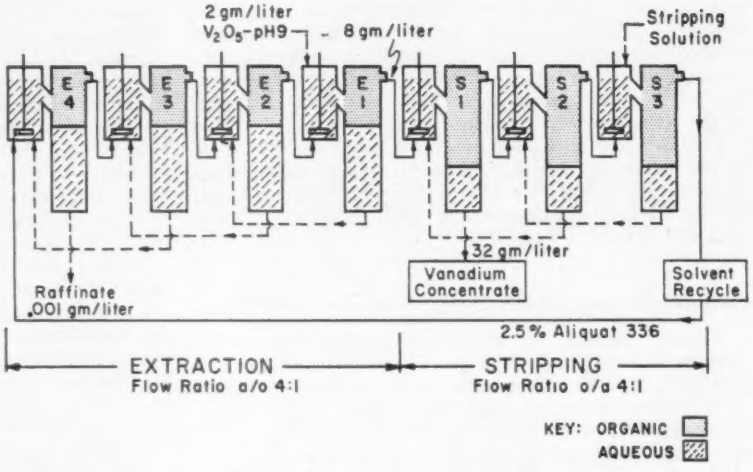


FIG. 1. FLOWSHEET of a liquid ion exchange process.

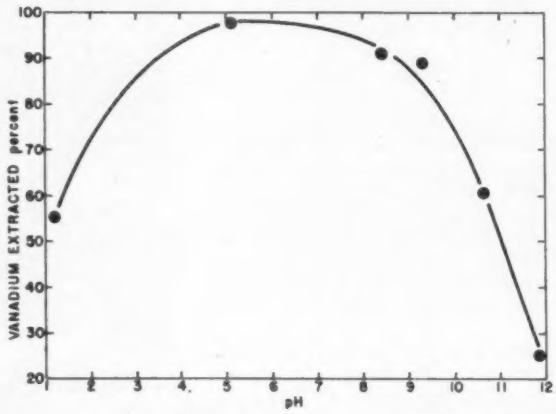


FIG. 2. VANADIUM EXTRACTION is most efficient in the pH range of 5 to 9.5.

ORGANIC: 0.094M. Aliquat 336
0.11 M. Isodecanol
Kerosene Diluent

AQUEOUS: 2.0 g/l V_2O_5
27 g/l sulphate
O/A RATIO: 1/1

Batch Extractions

The effect of pH on the extraction of vanadium is illustrated in Fig. 2.

These results show that extraction is most efficient under neutral or slightly acidic conditions. However, entirely acceptable results are obtained at pH values up to about 10.

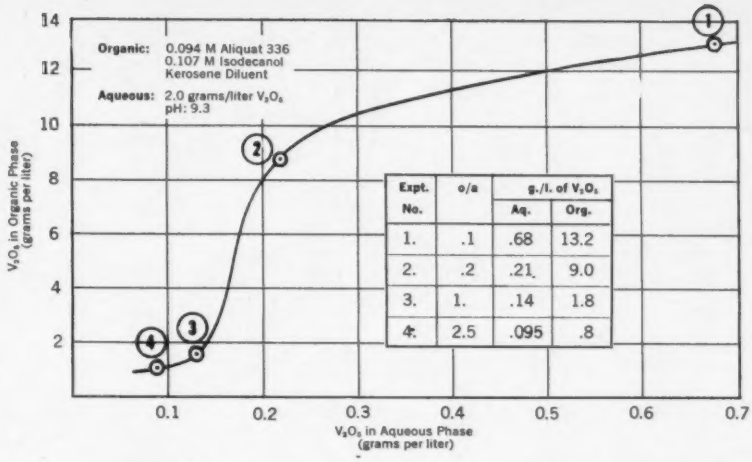
The pH value selected depends on the contaminants present in the vanadium solution. This illustrates the unique capability of Aliquat 336 to extract vanadium from basic as well as acidic solution. The extraction equilibrium curve at pH 9.3 is presented in Fig. 3.

These data show, as expected, that the extent of extraction increases with the organic:aqueous volume ratio. However, the increase is relatively slow below a 0.2 (1 organic:5 aqueous) volume ratio. Vanadium concentration in the raffinate is sufficiently

. Messrs. Dunning and Swanson are head and chemist respectively of the Chemical Research Dept., General Mills, Inc., Minneapolis. J. E. House, to whom all inquiries concerning this article should be sent, is manager of market development for General Mills' Chemical Div., So. Kensington Rd., Kankakee, Ill. This subject was presented at the 139th National Meeting of the American Chemical Society, St. Louis, Mo., March 1961.

low at this ratio so that a small number of extraction stages would produce economically efficient extraction.

In an effective metal recovery process, the metal must be readily stripped from its quaternary complex in the organic phase, in addition to being readily extracted in the first operation. A variety of stripping agents were tested for their effectiveness with a 0.094 M. quaternary and 0.11 M. isodecanol solution in kerosene. The organic phase had been used to extract vanadium (V) from an aqueous sodium vanadate solution at a pH of 9.3. This loaded organic phase contained 4.64 g/l vanadate as V_2O_5. The vanadate was stripped from this loaded organic solution in single-stage batch operation and the results are summarized in the accompanying table.



Expt. No.	o/a	g./l. of V_2O_5 Aq.	Org.
1.	.1	.68	13.2
2.	.2	.21	9.0
3.	1.	.14	1.8
4.	2.5	.095	.8

FIG. 3. VANADIUM extraction equilibrium curve for one-stage batch operation.

Chloride and Nitrate

These results show that chloride and nitrate ions are effective stripping agents of vanadate from the loaded organic. However, the use of such stripping agents leaves the quaternary as salt of the anion of the agent used. Therefore, the effect of chloride and nitrate ions on the extraction of vanadium was determined. The solution used in the original extraction work above (2g/lV_2O_5) was changed by adding NaCl or $NaNO_3$ to give a 0.5 M. chloride or nitrate concentration. Batch extractions were made with organic:aqueous ratio of 0.2. The results are illustrated in Fig. 4.

Although chloride and nitrate ions both depress the extraction of vanadium at high pH values, the chloride effect is smaller. These data show that a stripping agent, such as NH_4-OH-NH_4Cl, could be used, and that it would not be necessary to convert the quaternary to the sulfate form before recycling it to the extraction stage. The high efficiency of this fatty quaternary for the extraction of vanadium indicates that this process might be used to separate vanadium from other materials with which it is associated in leach liquors. Therefore, the separation of vanadium from chromium and phosphorus was studied.

An aqueous solution containing 0.15 M. Na_3VO_4 (13.3 g/l V_2O_5), 0.16 M. Na_2CrO_4 (24.3 g/l Cr_2O_3), 0.23 M. Na_3PO_4 (20.6 g/l P_2O_5) was extracted in single-stage batch operations with kerosene which contained 0.11 M. (7.4 wt. percent) quaternary and 0.25 M. (5.0 wt. percent) isodecanol. The pH was adjusted to various values with sulphuric acid. The data are illustrated in Fig. 5.

These results show that the extraction of chromate is most effective at low pH values. However, it probably would be more feasible commercially to use a pH of about 12 where chromate is effectively extracted and neither vanadate nor phosphate is appreciably extracted. At a pH of 9 vanadium is strongly extracted; it could be readily separated from both chromate and phosphate at this pH.

In general then, the results show that chromate and vanadate can be efficiently separated from each other by proper pH control. The two can be separated from phosphate anywhere in the basic region.

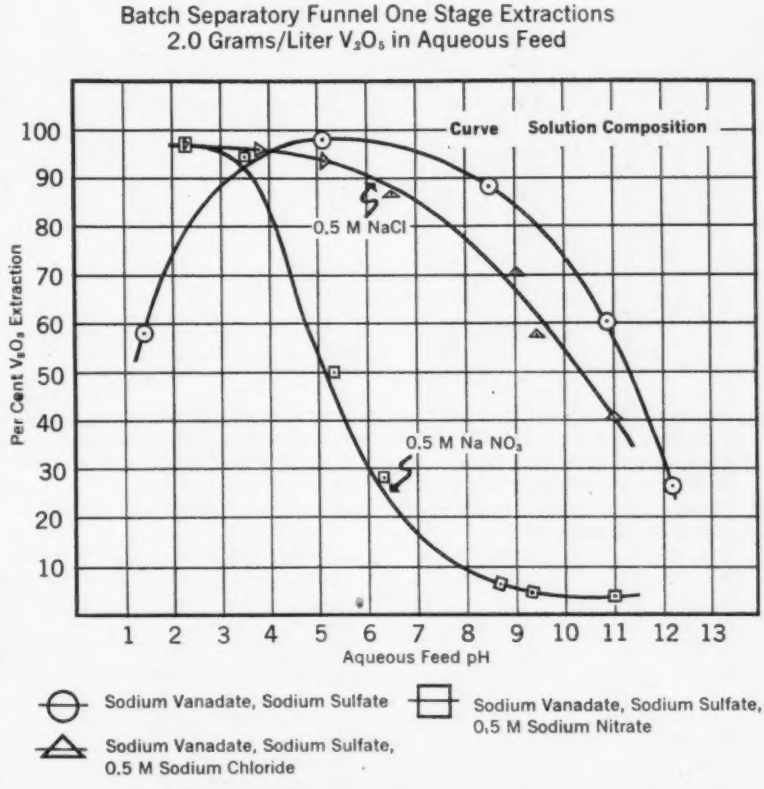


FIG. 4. HOW EXTRACTION VARIES with pH values in the presence of various anions.

Continuous Extraction

Basic Liquor, Electrolyte Stripping. The batch data indicated that vanadium (V) could be removed success-

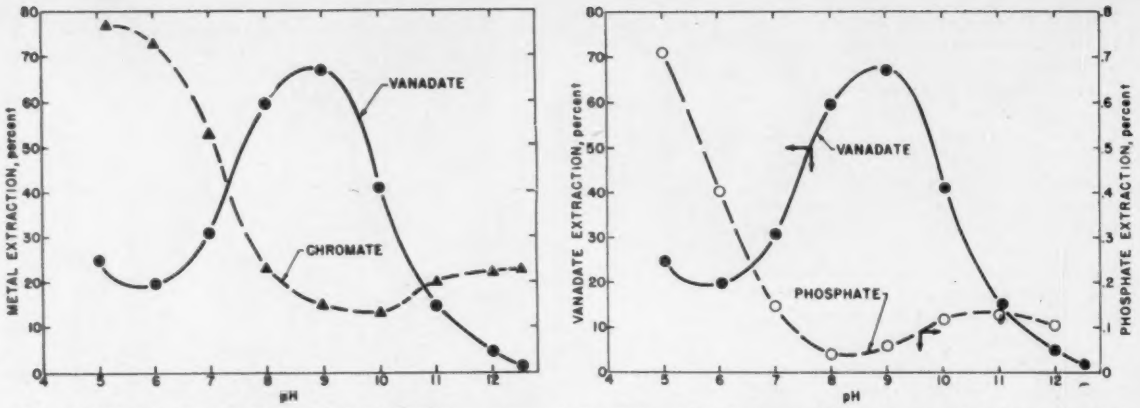


FIG. 5. VANADATE MAY BE SEPARATED from chromate by pH control. Both are effectively separated from phosphate by the liquid ion exchange process.

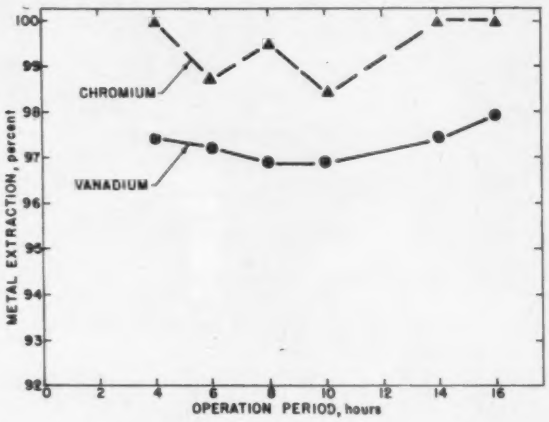


FIG. 6. CHROMIUM and vanadium are efficiently extracted from acidified ferro - phosphorus leach liquor.

fully from either acidic or basic liquors. The vandium values in a synthetic vanadium-bearing liquor at a pH of 7.8 were extracted in continuous laboratory apparatus similar to the schematic diagram in Fig. 1. Four extraction stages extracted 99.6% of the vanadium. The vanadium was stripped with NH_4OH-NH_4Cl and the resulting NH_4VO_3 precipitated, filtered, dried, and calcined to V_2O_5. This product analyzed over 99.9% V_2O_5.

Acidic Liquor, Electrolyte Stripping. The efficiency of quaternary LIX reagents in acidic media was investigated by continuous extraction of an aqueous feed resulting from tri-sodium phosphate crystallization of the leach liquor from a ferro-phosphorus calcine. The liquor was acidified to a pH of 6 before introduction to LIX circuit. The feed contained vanadium (25 g/l as V_2O_5), chromium (2.3 g/l as CrO_3) and phosphorus with minor amounts of impurities. The organic phase contained 0.092 M. (5.71 wt. percent) quaternary and 0.32 M. (6.4 wt. percent) isodecanol. The quaternary was used in the chloride form since chloride does not interfere with chromium and vanadium extraction in dilute acidic operation. Sulphuric acid (0.61 M.) was fed to the third extraction stage for pH control. The loaded organic was stripped with an aqueous 1.5 M. NH_4Cl and 0.9 M. NH_4OH solution. The continuous apparatus was composed of four extraction stages, one water-scrub stage, and two stripping stages.

Average conditions of operation (16 hrs) were as follows:

Flow Rates

Organic	1.1 l/hr
Aqueous Feed	0.63 l/hr
Strip Solution	0.26 l/hr
Recycled Strip Solution	0.62 l/hr
Sulfuric Acid	0.18 l/hr

Analysis

Aqueous Raffinate	0.33 ± 0.06 g/l V_2O_5 0.018 ± 0.002 g/l CrO_3
Stripped organic	1.9 ± 0.2 g/l V_2O_5 0.27 ± 0.08 g/l CrO_3

Vanadium and chromium extraction averaged 97.2 and 99.4% respectively. Results of this efficient continuous operation are illustrated in Fig. 6.

Investigation of the results show that a fourth extraction stage would have increased vanadium extraction to about 99%. The solvent (kerosene plus quaternary and isodecanol) entrainment during this operation averaged 0.056 lbs/lb of V_2O_5 or less than $0.01 per lb of vanadium recovered. Calculations of reagent consumption and entrainment losses indicate a cost of $0.14 per lb of V_2O_5 recovered. Therefore, the use of this quaternary in acidic media is competitive with existing processes. The tolerance to chromium of the stripping circuit needs further examination. Results above show that a saturated NH_4Cl solution with ammonia will quantitatively strip vanadium from the quaternary. An increased economical advantage will result from reuse of the NH_4Cl recycle solution. More recent results show that the cost of similar operations can be reduced to $0.06 per lb of V_2O_5 recovered from vanadate solutions.

Three Advantages

The use of chemically reactive stripping agents has several advantages over those that operate by mass action. Some of these advantages are: quantitative removal, fewer stripping stages, and lower chemical consumption. The reduction of vanadate and chromate ions to vanadyl and chromic ions changes them from anionic materials to cationic ones, thus very efficiently stripping them from anionic exchange materials. Previously reported[6] batch extractions show that SO_2 could be used to strip vanadium quantitatively from the quaternary.

Basic Liquor, Reducing Agent Stripping. Continuous extraction studies were conducted using 0.2 M. Aliquat 336 and 0.16 M. isodecanol in kerosene, and sulfur dioxide to strip the vanadium loaded organic. The flow diagram is illustrated in Fig. 7.

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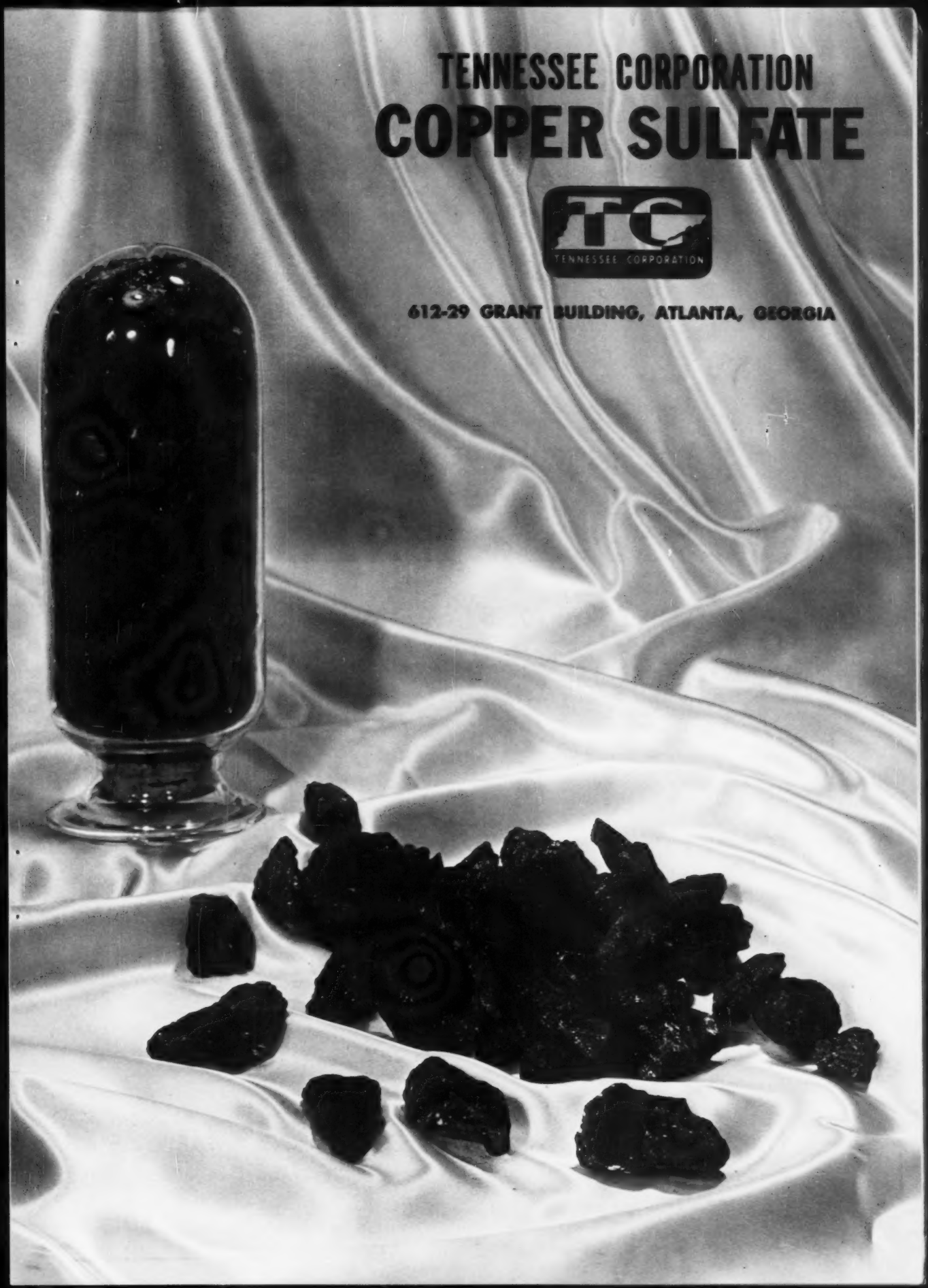

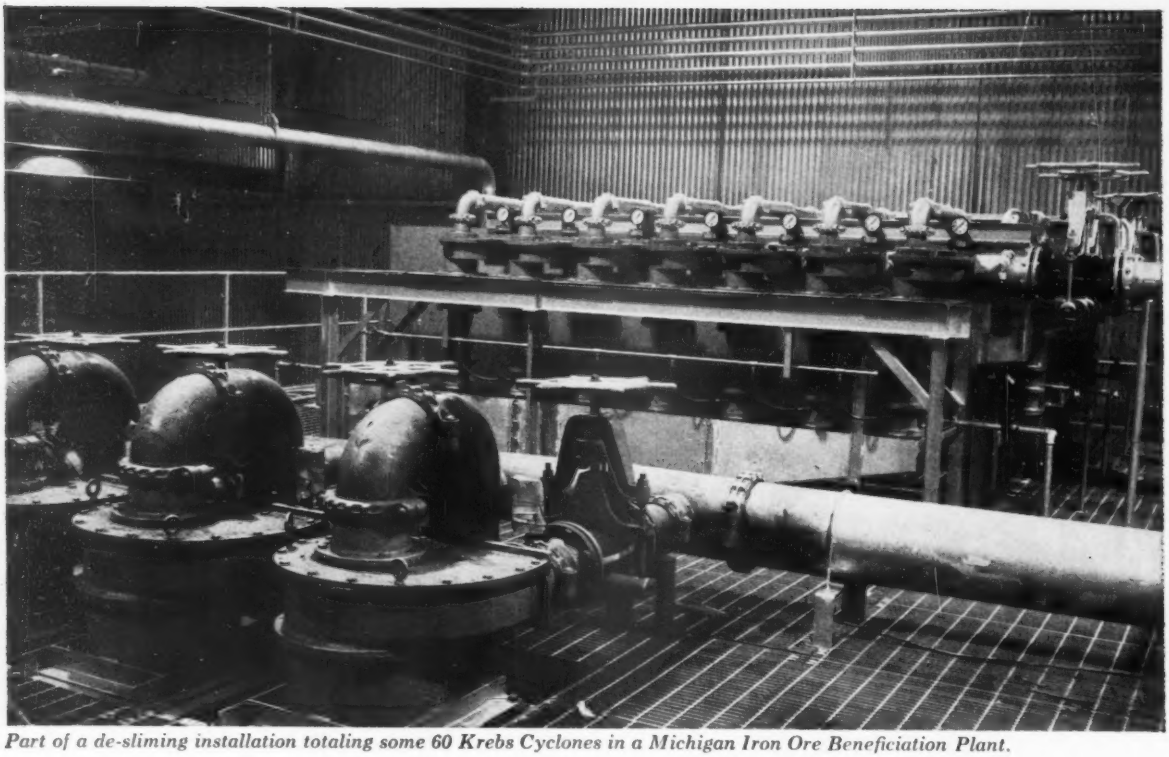

Part of a de-sliming installation totaling some 60 Krebs Cyclones in a Michigan Iron Ore Beneficiation Plant.

Why Krebs Cyclones give you Better Classification, yet cost less

Greater capacity per unit size Because the involuted feed entry on a Krebs Cyclone minimizes turbulence and pre-orients particles for efficient classification, a larger vortex finder can be used for a given size cyclone, providing higher capacity and equivalent separation for a given pressure drop. This same design feature can be used advantageously to obtain a finer separation for any equivalent cyclone, orifice combination and pressure drop.

Greater flexibility Because Krebs Cyclones are available with the widest variation in orifice sizes, including adjustable apex valves, they can be tailored more carefully to fit the precise requirements of a given job. As a result, Krebs Cyclones not only match capacity requirements with the highest degree of accuracy, but also provide the optimum in fineness and sharpness of separation.

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Because Equipment Engineers Inc. is devoted exclusively to cyclone technology, you get all the advantages of dealing with a specialist when you specify Krebs Cyclones. Your classification problems are studied by a staff of skilled engineers representing an unmatched accumulation of experience in the design and practical application of cyclones in the metallurgical field.

A significant factor in the success of every Krebs Cyclone installation is the careful engineering analysis which precedes it. To evaluate your classification needs, we maintain a pilot plant equipped for full-scale testing. From analysis of test results, Equipment Engineers metallurgists are able to predict over-all plant performance with a high degree of accuracy. Your inquiries are invited.

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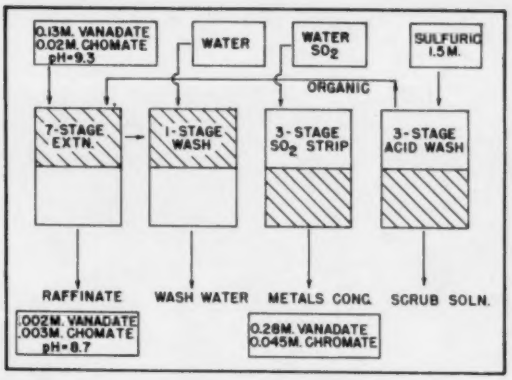

FIG. 7. FLOWSHEET FOR THE EXTRACTION of vanadate and chromate by the liquid ion exchange process.

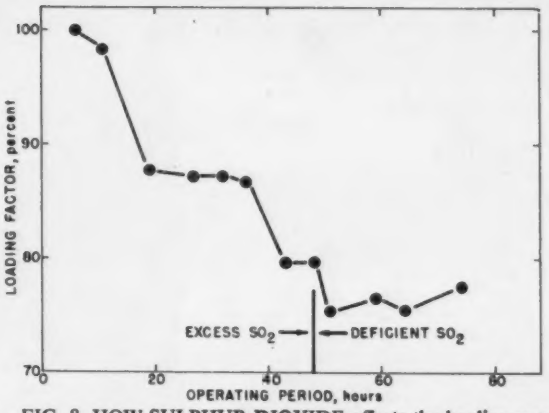

FIG. 8. HOW SULPHUR DIOXIDE affects the loading capacity of Aliquat 336.

In this study an excess of SO_2 was used through the 48th hr of operation. The reduction of the vanadate requires acidic conditions. It appeared that excess SO_2, to give such acidity, may be deleterious to the performance of the quaternary. Therefore, H_2SO_4 and a deficiency of SO_2 (less than stoichiometric amounts) was used from the 48 to 74th hrs. The results, shown in Fig. 8, indicate that this permitted the loading factor to remain constant.

Samples of the organic solution for which the loading factor had decreased to 85% of the original were treated to restore their loading. Scrubbing the samples with a total of 2.0 M. NH_4-OH-NH_4Cl or 2.0 M. NaCl with 1.0 M. NH_4OH increased their loading capacities to 90% of the original value. In commercial operations using a SO_2 strip, it may be desirable to treat continuously a small bleed stream (about 1% of the recycled organic) to maintain a constant high loading factor. Extensive analytical studies have shown no decomposition of the quaternary.

Conclusions

Single-stage batch extractions show that a suitable fatty quaternary ammonium compound (Aliquat 336) will extract vanadium from both acidic and basic aqueous solutions. Extraction is most efficient at a pH of 5 to 6, but entirely acceptable extractions were obtained up to pH values of about 10. Chloride and nitrate ions depress the extraction at high pH values. However, the chloride effect is small enough that the quaternary may be used in the chloride form.

Chromium, as the chromate ion, also is effectively extracted from acidic and basic solutions. The pH effect is specific enough so that chromium may be selectively extracted from vanadium at pH values over about 12; vanadium is most effectively extracted at a pH of about 9, where the extraction of chromium is near its minimum value. Phosphate extraction is very low in the basic pH range. Therefore, pH adjustment will permit the separation of vanadium and chromium from each other and from phosphate by LIX reagents.

Several electrolyte stripping agents are effective; a combination of caustic and electrolyte is most effective. Reducing agents, which convert the extracted anionic metals to cationic forms offer quantitative stripping.

Extensive continuous data with multi-stage extraction and stripping units corroborate these conclusions. These studies show that the liquid ion exchange process, using a quaternary, is competitive with cationic solvent exchange processes. In addition, the quaternaries are highly effective for processes which must operate, for economic or technical reasons, with alkaline liquors.

Chloride and Nitrate Salts Are Effective Stripping Agents

Stripping Reagent	Stripped Organic V_2O_5 Analysis (grams/liter)	Per Cent V_2O_5 Stripped	Distribution Coefficient E o/a
2.0M Na_2SO_4	4.60	0.9	0.04
1.5M NH_3	4.58	1.31	0.07
1.0M Na_2CO_3	3.94	15.1	0.89
1.5M NaCl	3.79	18.4	1.12
1.0M NaOH	3.60	22.4	1.45
1.5M NH_4Cl	2.88	37.8	3.05
1.0M NaOH—0.7M Na_2SO_4	2.24	51.8	5.35
1.5M NH_4Cl—1.5M NH_3	1.16	75.0	15.00
1.5M NaCl—0.75M NaOH	1.10	66.3	16.09
1.0M $NaNO_3$	0.84	81.8	22.62
1.5M NH_4NO_3	0.05	99.0	459.00

Acknowledgments

The authors are indebted to J. L. Drobnick and C. J. Lewis, Colorado School of Mines Research Foundation, for their contributions to this study.

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OPERATING IDEAS

Pima Builds Versatile One-Man Drill

PIMA MINING CO. has built the unique drill assembly shown for use at its large open pit near Tucson, Ariz. The unit has solved the problem of safe and economic auxiliary drilling along established benches and other points in the pit, including blockholing. Because it is self-propelled, it can be moved quickly to any point in the pit accessible by road where drilling is required.

The drill is completely self-contained and carries a 315-cfm I-R rotary compressor, a pressurized water tank holding about 200 gal of water (20 psi) and a Type AW 452 "HBEC" Hydra-Boom equipped with a FM4 wagon drill mounting with 4-in. drifter drill. All equipment is installed compactly, yet easily accessible, on a GM Model LV400C truck.

A 4-IN. DRIFTER, mounted on a Hydra-Boom, is remotely controlled by an operator on the truck. This set-up allows fast secondary drilling in Pima Mining Co.'s large open pit near Tucson, Ariz. The driller also drives the truck.

Both truck and drill are operated by one man. As the drill and mountings are remotely controlled from a panel just behind the hydraulic boom mounting, the operator is protected from possible rock spills and falls.

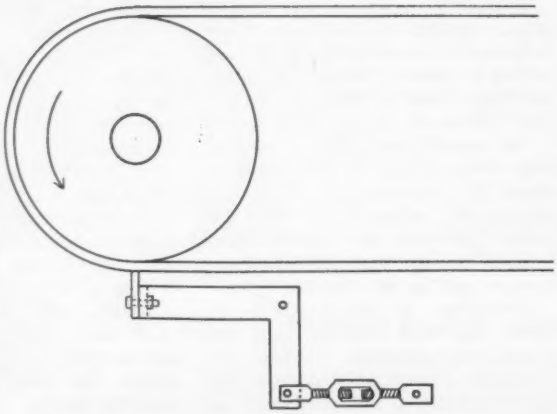
Portable Light Tower for Open Pit

THIS PRACTICAL and self-contained light tower is used by Pima Mining Co., Tucson, Ariz., for illuminating pit area active during the swing and night shifts. It was constructed at the company's general repair shops, and in design closely follows that operating in the neighboring Asarco pit under development. Novel construction features are the pivoted and the counterbalanced tower mast and method of positioning the four flood lights. Electric current for the flood lights is furnished by a Kohler Model 5CM-61 lighting plant made up of a 5-kw generator unit and a Lister-Blackstone Model SL2Z9 8 to 10-hp diesel engine. The diesel fuel for the plant is stored in a tank holding about 53 gal. All equipment units are mounted on a two-wheel trailer. Four adjustable pipe supports or posts welded to each corner of the trailer frame lend extra stability when the tower is in operation. Transportation of the tower to a new location is a simple matter. It involves releasing the lock mechanism at the foot of the tower column, tilting the tower column to a horizontal position, locking the tilted column, and releasing the four posts on the trailer frame after the trailer has been coupled to a light truck or jeep.

Mann & Millard Devise An Effective Belt Scraper For Wet, Sticky Ores

CONVEYOR BELT SCRAPERS come in many shapes, sizes and forms, but their lack of success is demonstrated by the number of designs that are continuously being produced. A simple belt scraper that successfully cleans belts handling wet, sticky ores with virtually no maintenance has recently been developed by C. W. Mann and J. A. Millard of the maintenance department of Union Carbide Ore Co., Newport, News, Va.

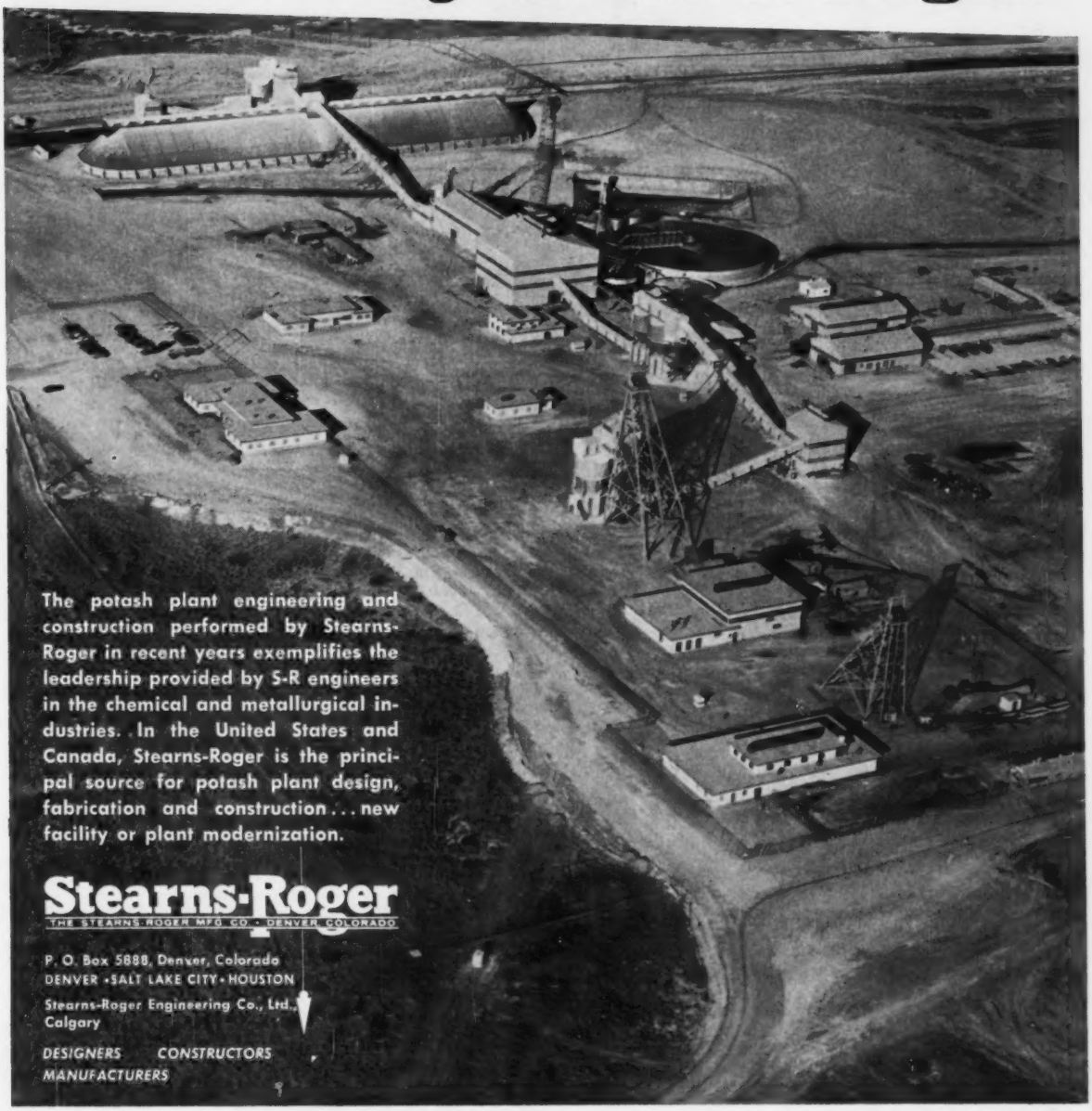
The scraper, installed as shown in the sketch, must be made of ¾-in.-thick soft gum rubber. In order to do a successful cleaning job, the scraper must exert only a very light pressure on the belt and the adjustment for this pressure is supplied by a turnbuckle which takes the place of the conventional counterweight. Any more pressure applied to the belt by the scraper than what is best described as a light touch and any other than a soft gum rubber scraper will preclude successful belt cleaning. Wear on both the scraper and belt is almost nonexistent.



processing plants

for potash

by Stearns-Roger



The potash plant engineering and construction performed by Stearns-Roger in recent years exemplifies the leadership provided by S-R engineers in the chemical and metallurgical industries. In the United States and Canada, Stearns-Roger is the principal source for potash plant design, fabrication and construction . . . new facility or plant modernization.

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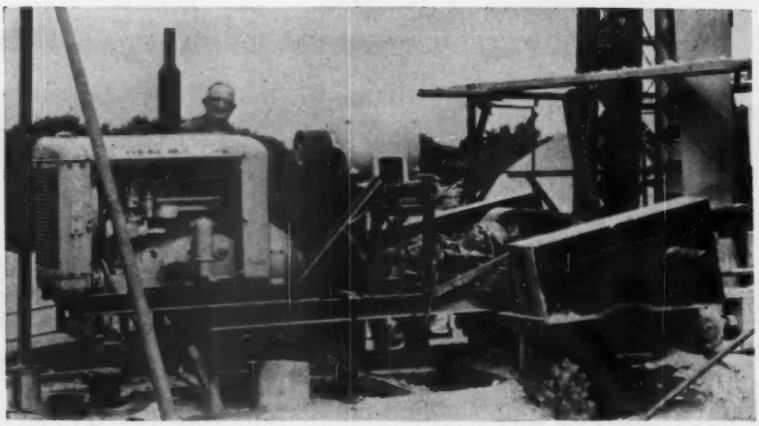
OPERATING IDEAS (Continued)

Electric Motor Takes Surge Load

W. M. HAITH, Beatrice, Neb., used a diesel engine to power a limestone crusher. However, the governor would accelerate the engine at a frequency in excess of 12 times per minute because of power surges under load.

As suggested by The Gates Rubber Co., an electric motor was connected to the engine drive shaft through a V-belt drive. When the crusher takes a heavy load, the over-running electric motor takes up the surge by boosting the power to the shaft. The drive has been functioning successfully for three years.



New Seats & Belts Aid Timken Drivers

NEW TORSION SPRING suspension seats with seat belts attached to the floor and seat for greater safety have been installed on 13 long-distance trucks of The Timken Roller Bearing Co. Company safety engineers said that the belts and seats will provide even greater safety to the drivers of the trucks who have established a record in recent years of no man-hours lost through accidents.

With the new installation, drivers who secure the belts to their bodies will find less vibration and there will be less possibility of irritation from the belt to the driver. The backs of the seats have a semi-bucket appearance. The new belt buckles have been improved so that they can be released more quickly if necessary than the older type buckle.

USBM Develops Explosive Rock Bolts

A NEW TYPE of rock bolt for mine roofs, one which is anchored by means of an explosive charge, has been given preliminary tests by the Spokane Research Office, U.S. Bureau of Mines. Edward W. Parsons, mining methods research engineer, said that explosive forming in some cases may provide a more positive method of anchoring bolts.

So far, Parsons has found that the design of explosive rock bolts will be different from that of existing rock bolts and undoubtedly the cost will be greater. He said the object is to obtain anchorage in rock material where the wedge or expansion shell types do not afford sufficient area of contact.

Several bolts were recently test fired at the Hecla Mining Co.'s Star Mine near Burke, Idaho, and Parsons said

the results were encouraging. In his experiments, Parsons has used a blasting cap alone and also a blasting cap and a charger. Various types of caps and explosives have been tried. The charge usually is placed in a metal capsule that goes inside the tube of material to be tested and is water-coupled to put equal pressure on all points in the blast. Most of the work to date has been done in the laboratory, using a steel block to simulate rock conditions. A principal problem has been in creating an explosion which will expand the hollow end of the steel bolt without shattering it.

Mine Faces Sampled Under Ultra-Violet Light

A PHOTOGRAPHIC METHOD has been developed in Europe to map and sample scheelite mines. Because scheelite fluoresces, photographs taken under ultra-violet light at the breast allow an over-all estimation of ore concentration.

According to the EUROPEAN TECHNICAL DIGESTS:

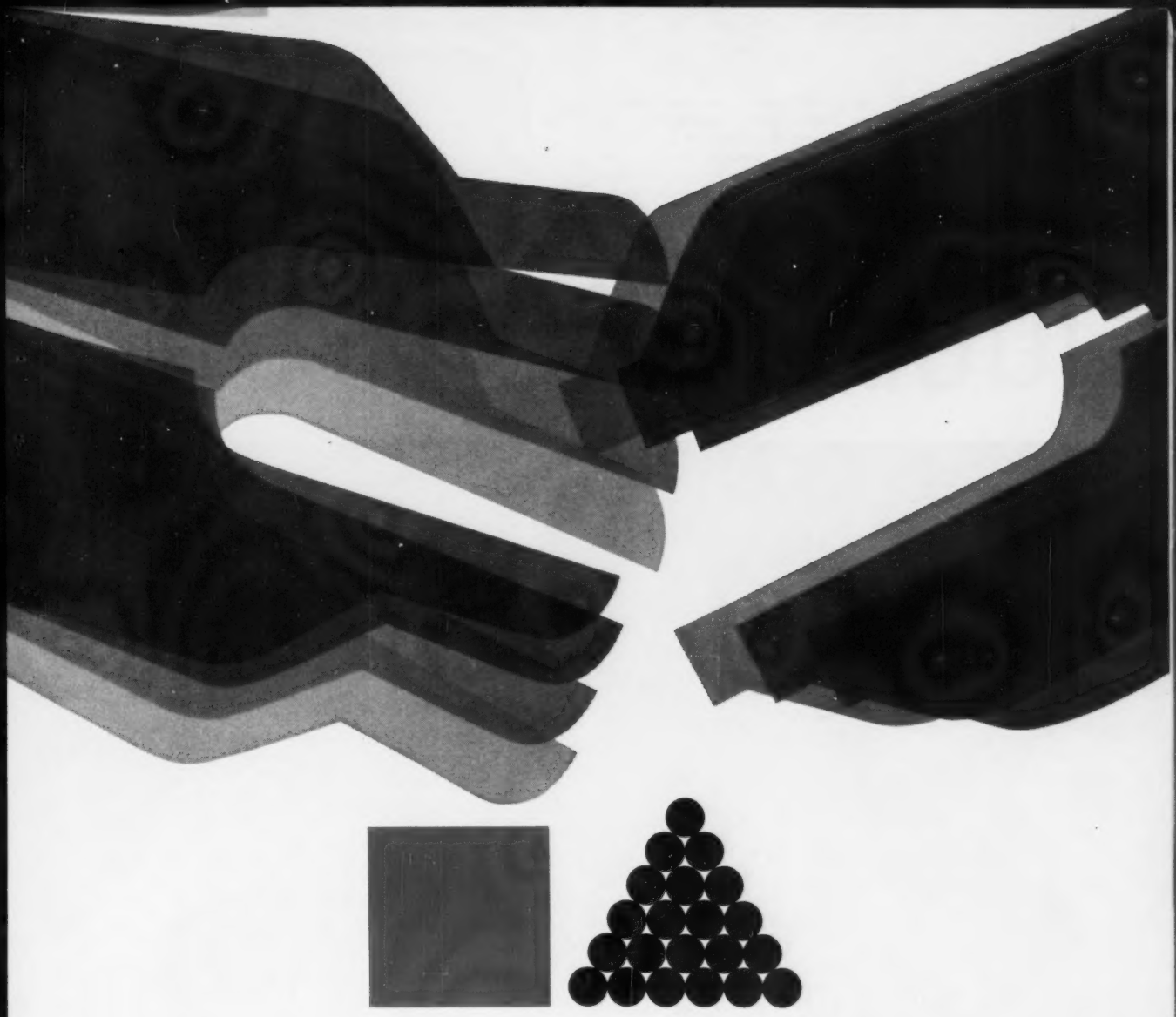
- the breast can be examined over its entire area
- errors due to wide variations in ore concentration can be minimized
- the method yields objective results
- the pictures are readily reproduced.

The photos were taken with an "Exakta Varex II," a camera equipped with a UV-filter. Ultra-violet lamps with 1-3 mercury-arc lamps were used. Since grain was not objected to, high-sensitivity films could be employed.

Further expedients included marking the face with a luminous paint to avoid confusion between different shots, and a luminous yardstick used for comparison purposes. The pictures can be displayed in natural scale or any scale desired by projection onto a screen.

Photographs are projected over a glass plate backed with 5-mm-squared paper. The linear portions of the ore components are measured, according to the Rasival method, and substituted for area portions. Successive evaluations of fresh photographic records taken as the work on the face progresses by 1 m, allow an over-all estimation of the ore concentration.

The method is applicable to all fluorescent ores. Color photography, which permits better visual differentiation, further improves the efficiency of the process.



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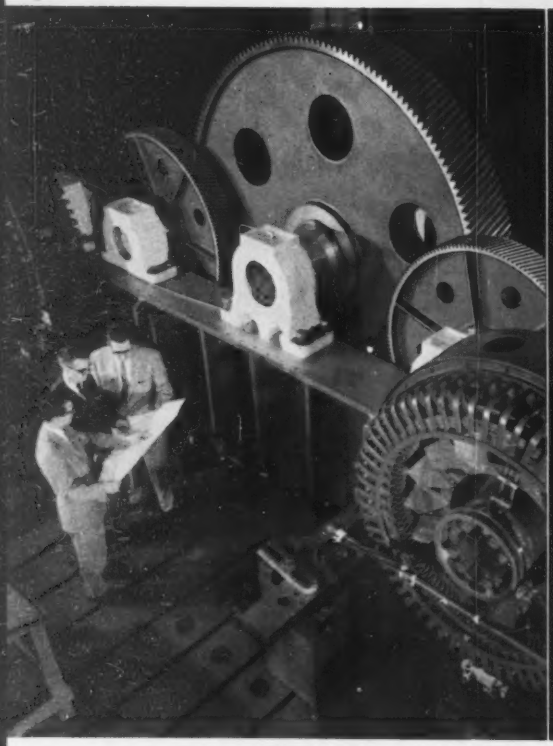

Full-load demonstration proves 98%-plus drive efficiency: A-C factory engineers recently demonstrated the high efficiency of TWINDUCER grinding mill drives. It ranged from 98.48% to 98.52%. This exclusive twin motor drive system divides mill load electrically, saves space, installation costs, minimizes gear wear.

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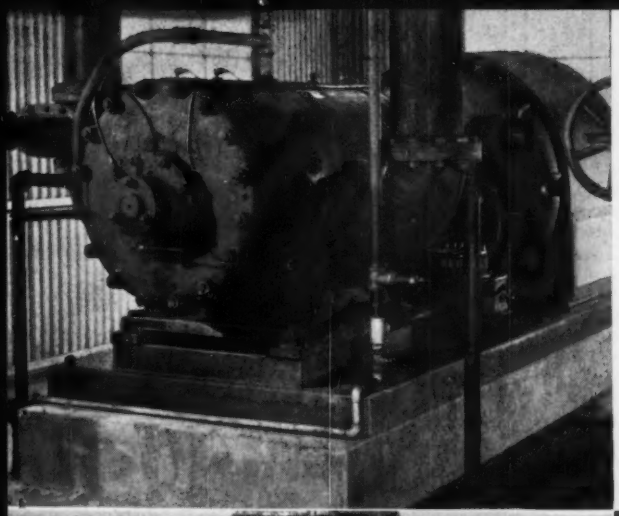

Constant vacuum . . . year after year: RO-FLO vacuum pumps with sliding-vane rotary design eliminate operating losses inherent in reciprocating machines. Centrifugal force keeps vanes in close contact with cylinder walls, automatically compensating for wear. In addition, few moving parts required reduce wear, simplify maintenance.

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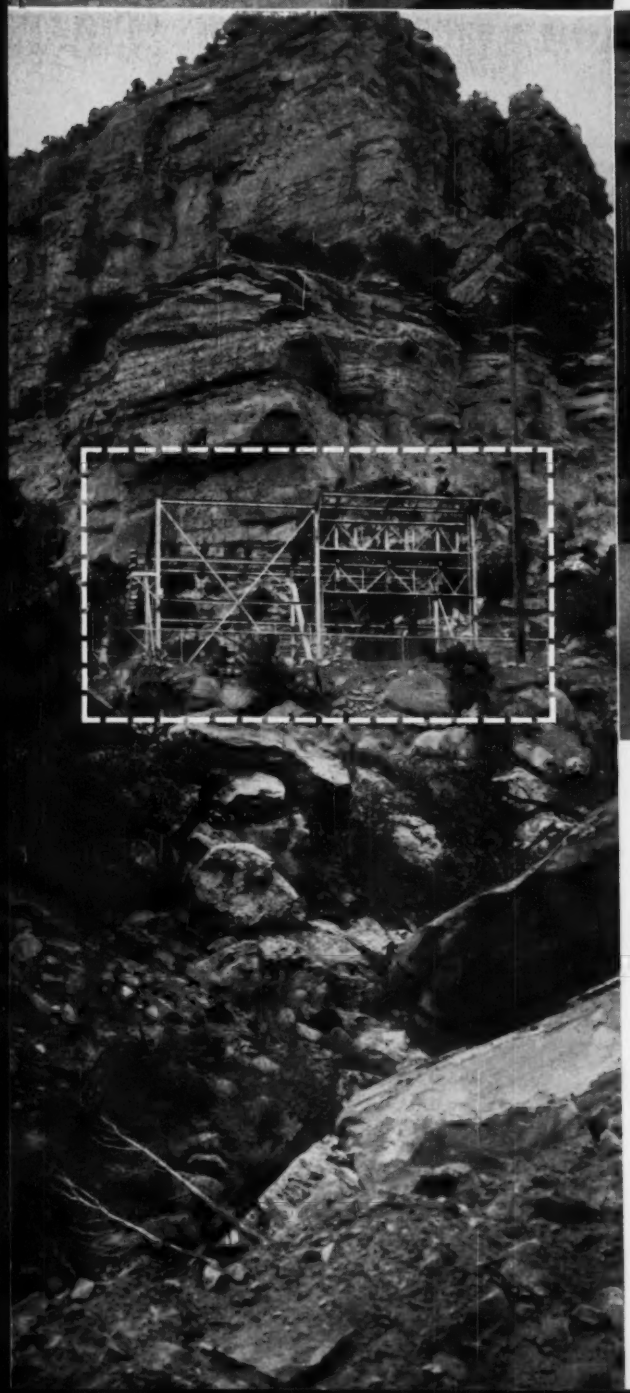

Reliable performance that's one mile high: This A-C substation has completed about five years' service 6546 feet up the remote Wasatch mountains of eastern Utah. Equipment survived rugged transportation up the mountain side on steel skids or trucks over rough bulldozed road. One switchgear fell from truck but was not damaged beyond a few dents. Picked to give dependable performance in this inaccessible, practically unserviceable location, A-C substation has proved out well beyond expected performance.

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ALLIS-CHALMERS

PERSONALS

Nels W. Stalheim, who has been serving as chairman of the board of Federal Resources Corp., has been named president and chief executive officer. **Floyd B. Odlum** becomes chairman of the board of directors and senior officer, and **Ralph W. Neyman** retires as president of the company to continue as a consultant on a part-time basis. Federal Resources has beryllium, uranium, silver and petroleum interests in several states.

Stalheim

Neyman will continue directing the company's Conjecture silver mine project in northern Idaho, where Federal is deepening a three-compartment shaft to the 2000 ft level and then drifting at this level in an extensive development project. Before joining Federal in 1956 as president and general manager, Neyman had spent more than 25 years with Hecla Mining Co., several as general manager.

Assumption of the chairmanship of Federal's board marks Odlum's return to active responsibility in the industry since his resignation from the Atlas Corp. in 1960, having formed the company in 1923 and having been its chief executive continually until retirement.

Stalheim, who has been acting as head of the company, will be the chief executive in charge of active management of Federal Resources. The company controls the rich Radon Uranium mine in southwest Utah, is operator with a 50% working interest in the Conjecture silver mine, serves as operating partner with a 60% working interest in the Federal-Gas Hills Partners uranium mining and milling complex, and is a principal owner in Beryllium Resources, Inc.

Arthur L. Wells, Sr., has been promoted from general maintenance foreman to maintenance superintendent at U.S. Borax and Chemical Co.'s Carlsbad potash mine. He will be responsible for all maintenance and repair work at the mine site.

Lewis Fairbanks, plant engineer at the mine, has been promoted to assistant maintenance superintendent.

Roger H. Chapman has joined the staff of the California State Div. of Mines and Geology to head up a new geophysical research program which will include compilation of geophysical anomaly maps of the state based on data from private and public sources and a determination of the usefulness of geophysical methods for prospecting for such specific mineral commodities as chromite.

Chapman was with the Columbia-Geneva Div. of the U.S. Steel Corp. where he held the title of senior exploration geologist (specializing in geophysics).

J. Stuart Nebeker has been appointed smelter operations superintendent of Kennecott Copper Corp.'s Chino Mines Div. He replaces **Wesley C. Dow** who has been transferred to Kennecott's Utah Mines Div.

Nebeker has been employed at Chino since February 1959 when he came to Chino as a metallurgist at the smelter. Prior to becoming superintendent, he was a reverberatory foreman.

He was employed by American Smelting and Refining Co. as a metallurgist from 1943 to 1949 except for two years with the U.S. Army during World War II. From 1949 to 1958, Nebeker was a general foreman for the United States smelting and Refining Co. Prior to coming to Chino, he was a sales representative for Morris P. Kirk and Son, a subsidiary of National Lead Co.

Otto C. Klein has been named to the newly-created position of assistant director of research for American Zinc, Lead and Smelting Co. and its subsidiaries. He has served the American Zinc Co. for the past 10 years, primarily in the metallurgical and research departments. Before that, he spent 12 years with the pigment division of The Glidden Co.

Alfred L. Ransome, formerly with the U.S. Bureau of Mines, has been appointed a Foreign Service Reserve Minerals Officer assigned as Minerals Attaché to the Embassy at Rio de Janeiro, Brazil. He will continue to work with the Division of Foreign Activities of the USBM although he will no longer be with the Bureau officially.

George M. Meisel, ore beneficiation engineer, has joined Kaiser Engineers as a development engineer, mining and minerals division. In his new post Meisel will be responsible for development of new metallic and nonmetallic minerals engineering and construction projects for the company throughout the United States and Canada.

Meisel

Before joining Kaiser Engineers, Meisel was a project engineer for one of the nation's largest nonferrous corporations. During his career as a professional engineer, Meisel has specialized in both staff and field engineering for firms employing heavy media separation, classification, drying and roasting processes, and he currently holds several U.S. patents in these fields.

Meisel is a registered professional engineer, State of Colorado, was awarded a degree in mechanical engineering from Vienna Tech. and is a member of both the Colorado Society of Engineers and the American Institute of Mining, Metallurgical and Petroleum Engineers.

Dr. A. K. Snelgrove, head of the department of geology and geological engineering at the Michigan College of Mining and Technology, has been appointed as a Fulbright lecturer in economic geology at the University of Sind, Nyderabad, West Pakistan, for 1961-62. In 1953-54, Dr. Snelgrove held a similar post at the University of Hong Kong. In addition to teaching graduate students, Snelgrove will advise on curriculum matters.

En route to Pakistan, Dr. Snelgrove will attend scientific congresses in Honolulu and Hong Kong, the latter as a guest of the University at its Golden Jubilee celebration where he will give a paper on the geology of lead mines in the new territories of China.

Dr. Phillip L. Merritt, consulting geologist of New York City, has been named vice president of Hidden Splendor Mining Co. at Salt Lake City. Merritt will direct an expansion in acquisition of minerals properties by Hidden Splendor. The firm is presently active in beryllium, asbestos, uranium, and oil and gas developments in the western states.

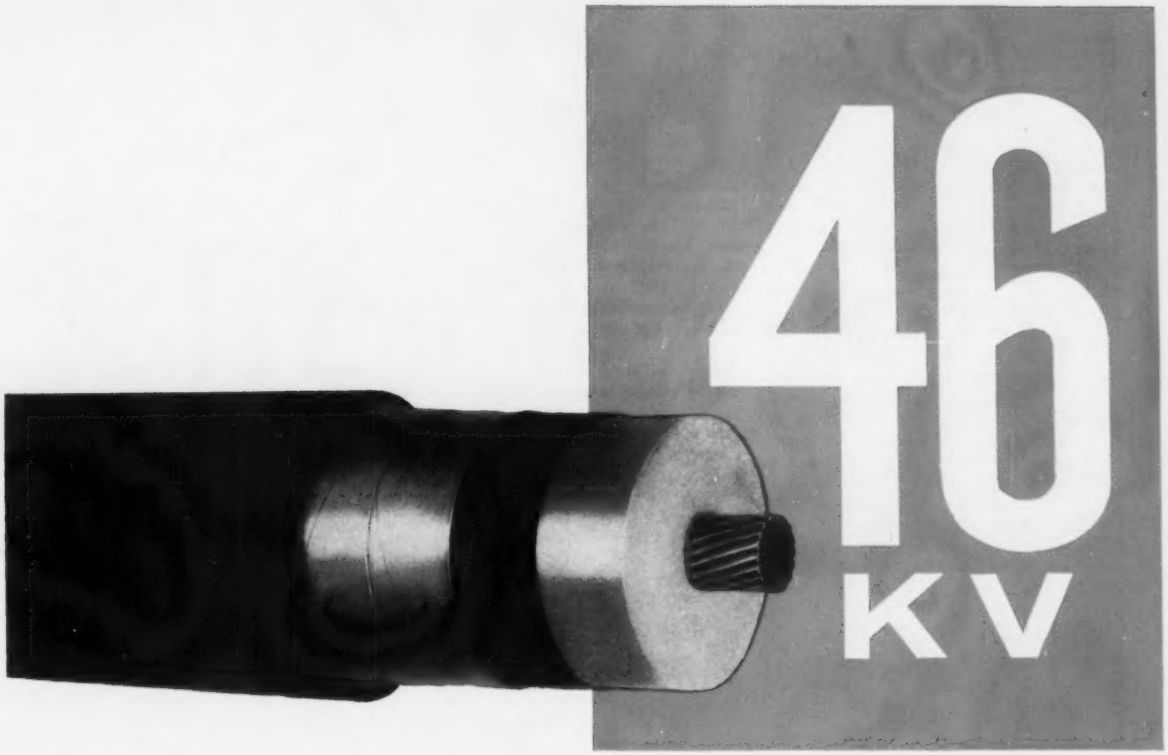
Merritt

Merritt, a graduate of the University of Minnesota, received his doctorate from Columbia University. He was geologist in charge of the raw materials procurement program of the Manhattan Project, and served with the Atomic Energy Commission after World War II until 1954. As assistant director of the AEC Division of Raw Materials he was in charge of both domestic and foreign exploration for the Commission.

Merritt has also served as a geologist with Selection Trust Ltd., Northern Rhodesia; geologist, mineralogist and ore dressing engineer at Stamford, Conn., facility, American Cyanamid Co. He was a major in the U.S. Corps. of Engineers prior to his work in the atomic energy field.

Merritt resigned from the AEC in 1954 to become senior geologist for E. J. Longyear Co. in New York. For the past two years he has served as consulting geologist. He has been a consultant to Hidden Splendor for the last several years.

Virgil Kauffman, chief executive of Aero Service Corp., Philadelphia, since 1924, has now become chairman of the board with executive powers in one of several management changes in that company. **George Strawbridge,** formerly executive vice president, has been named president. **Thomas M. O'Malley,** who joined Aero's staff in 1936, becomes vice president in charge of all operations. **Burtram McClain,** with Aero since 1945, becomes vice president, finance.



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PERSONALS *(Continued)*

Douglas R. Nichols, Jr., has been elected executive vice president of Nichols Engineering & Research Corp., New York, engineers and suppliers of mineral processing equipment to industry. He is a director of the firm, and served formerly as vice president and treasurer.

A graduate of Princeton in 1942, Nichols also serves as a director and president of Nichols Engineering & Research Corp. of Canada, Ltd., Montreal.

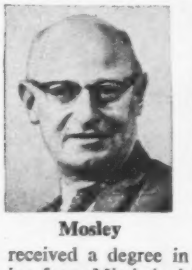
George H. Love has resigned as chairman of the board of The M. A. Hanna Co., an office he has held since 1956. A successor has not been named. Love announced his intention of resigning the Hanna chairmanship when he was elected chairman of the executive committee of Chrysler Corp. last month. He will continue to serve as a director of The M. A. Hanna Co. and of The Hanna Mining Co.

OBITUARIES

E. A. Schroer, 67, former mill superintendent of Kennecott Copper Corp., died in El Paso, Texas, August 2.

Schroer was born in St. Louis, attended the Missouri School of Mines, and took his first mining job in 1915 with the Butte-Superior Mining Co. in Butte, Mont. In 1922, he moved to Hurley, N.M., starting as head sampler at the mill, where he later held a variety of jobs, becoming general mill foreman in 1937 and assistant mill superintendent in 1948. Schroer headed Kennecott's Chino milling department from 1948 until his retirement January 1, 1958. Since that time, he has made his home in El Paso.

L. C. (Mose) Mosley, manager of the mining division of Marion Power Shovel Co., died August 28 in Cleveland, following heart surgery. He had been associated with Marion for 36 years and was manager of the firm's mining division since 1946.



Mosley

A native of Melvin, Ala., Mosley received a degree in electrical engineering from Mississippi State College. Prior to joining Marion, he was associated with General Electric Co. and Hudson Coal Co., Scranton, Pa.

Mosley joined Marion as an application engineer in 1925. Specializing in the application of Marion shovels and draglines for open pit coal mining, Mosley studied mines all over the U.S. and Canada and developed mining plans for many foreign countries. For many years he was active in the American Mining Congress, the National Crushed Stone Association, the National Sand and Gravel Association and the American Institute of Mining Engineers.

Arthur Notman, 78, a consulting mining engineer and geologist, died recently in New Work. An authority on copper, he was consulted by numerous mining companies, individuals and brokerage houses. In 1932 he was president of the Mining and Metallurgical Society of America. Notman received a B.S. degree from Harvard in 1903, sutdied mining engineering at Columbia University, and received a mining engineering degree from Harvard in 1908.

For the next several years, Notman was a mining engineer and geologist in copper mining operations of Phelps Dodge in Ariz. In 1917 he became assistant superintendent of a Phelps Dodge copper mine at Bisbee, Ariz., and later its general superintendent. At his death, he was president of Verde Exploration, Ltd., a copper mining exploration concern in Ariz. He was a director of several leading mining companies. During World War II, Notman served in London with the Mission for Economic Affairs. In 1944, he was planning director of the War Shipping Administration for the United Kingdom and Continental Europe.

He was a member of the American Institute of Mining and Metallurgical Engineers, the Society of Economic Geologists, the American Academy of Political Science, the American Association for the Advancement of Science and the Canadian Institute of Mining and Metallurgical Engineers.

Donald Bassingthwaite Angus, 55, well-known Canadian metallurgical engineer, died August 10. He was considered an authority on the extractive-metallurgy of uranium ores.

Angus was born in North Bay, Ont., and was graduated from Queen's University in the Faculty of Applied Science in 1928. He then joined Central Patricia Gold Mines (Quebec) Ltd., holding various positions including that of mill superintendent and mine manager. In 1951, he joined the staff of Eldorado Mining & Refining Co. Ltd. as mill superintendent of the Port Radium Mine on Great Bear Lake. At this time, extractive uranium metallurgy was in its infancy and Angus contributed much to its eventual operating success. In 1953. he joined the staff of Russell M. Way as consulting metallurgist. In this capacity he was responsible for much of the early planning and design of the numerous uranium-leach plants erected in the Elliot Lake area. He contributed substantially to the successful application of the milling and leaching methods, as well as assisting in solving many of their complex operating-metallurgical problems.

In 1958, Angus joined the staff of Roman Corp. Ltd. as consulting metallurgist. In this position he was closely associated with the Milling and Metallurgical Div. of Denison Mines, Ltd., which operates the largest acid-leach plant of its type in the world.

Angus was a member of the Engineers Club of Toronto and the Canadian Institute of Mining Metallurgy.

Charles C. Gates, 84, president of the Gates Rubber Co. of Denver, died August 29. Gates was a graduate of the University of Michigan and Michigan College of Mining and Technology. From 1904 until 1911, he was active as a mining engineer throughout the West. Then Gates bought the Colorado Tire and Leather Co. in Denver, and out of that one-man shop grew the Gates Rubber Co., the nation's sixth largest rubber manufacturing concern. a multi-million dollar corporation and one of the few remaining major U.S. companies still owned and managed by the founding family. Gates has been president of the company since its founding in 1911.

Gates

Gates was a member of various Masonic organizations and of two engineering and mining fraternities, Tau Beta Pi and Sigma Rho, as well as The Rotary Club of Denver and of Honolulu, The Denver Club, The Denver Country Club and The Tower Club of Denver. During his business career he served as a director of the Mountain States Telephone and Telegraph Co. and the Denver Council of Boy Scouts. He has also served as a trustee of the Denver Museum of Natural History and the University of Denver, which awarded him an honorary degree of Doctor of Public Service in 1951.

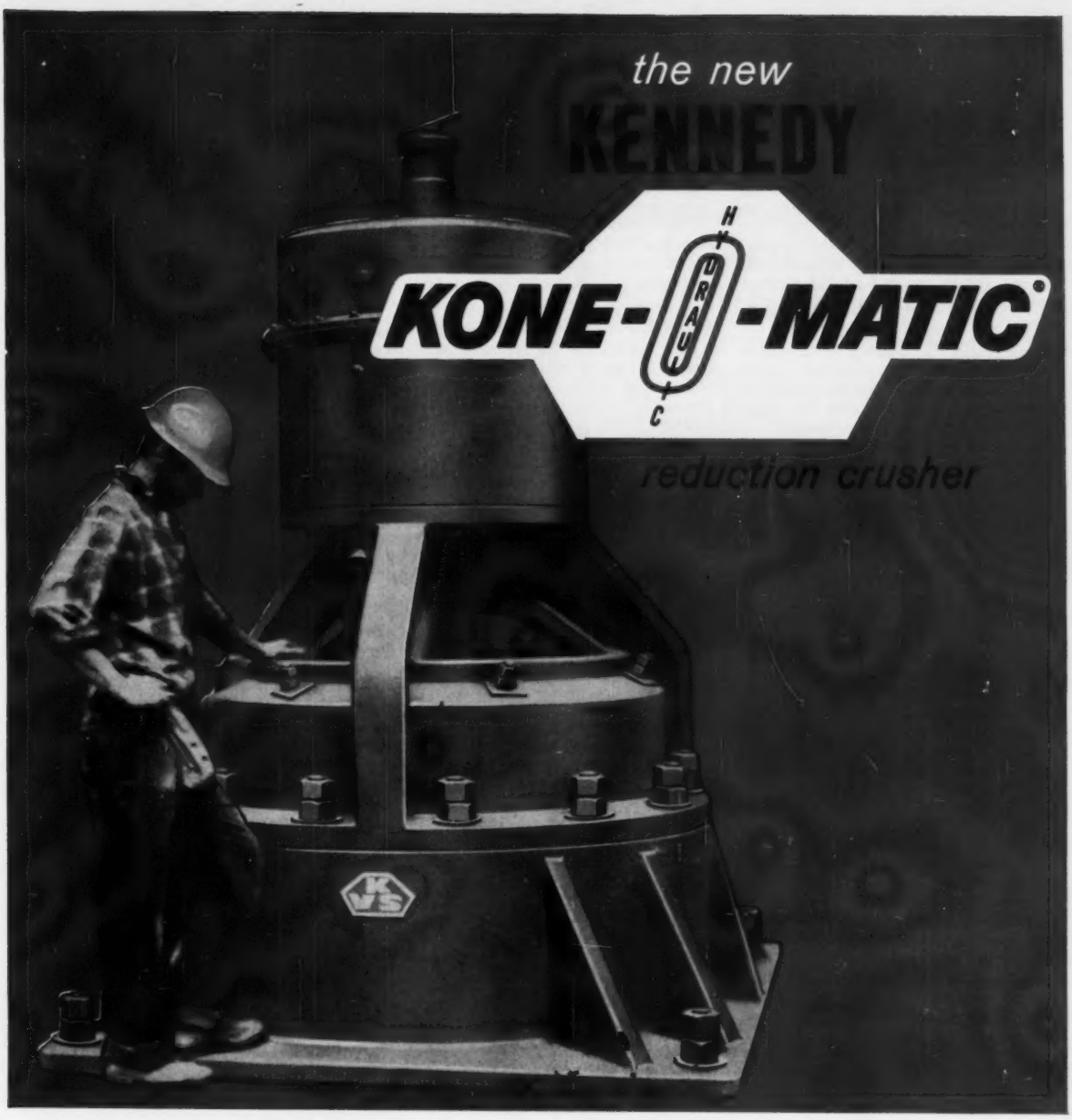
Gates will be succeeded as president of the company by his son, **Charles C. Gates, Jr.**

Frederick T. Thwaites, 77, professor emeritus of geology at the University of Wisconsin, died June 7. He had retired in 1954.

Edward Charles Bolitho, 68, died at Ely, Minn., June 25. He had been fee representative since 1927 of the Pioneer underground mine at Ely operated by Oliver Iron Mining Div., the Zenith underground mine at Ely operated by Pickands Mather & Co., and the Peter Mitchell taconite pit at Babbitt of Reserve Mining Co.

Joseph Gold, 38, manager of the diamond mining and drilling bit department of the Diamond Tool Research Co., New York, died June 10 after a sudden heart attack. He had been with DTR for seven years, having previously served the industrial diamond concerns of J. K. Smit and Sons, Inc. and Anton Smit and Co., Inc.

Gold was an active member in the American Institute of Mining, Metallurgical and Petroleum Engineers, as well as other professional organizations.



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Industry Wins and Losses Tallied at AMC

The following abstracts of talks and papers given at the American Mining Congress meeting in Seattle represent highlights of the meeting as covered by E&MJ staff members on the spot. The highlights are indexed in the box at the right to provide a guide to areas of specific interest.

Tom Nolan, the director of USGS, in observing that other industries spend about 4% of sales value for research, while mining spends less than 1%, stipulated three areas in which research is necessary in mining:

1. Develop new uses for raw materials now in use.
2. Develop processes to extract materials from low-grade uneconomic mineral deposits.
3. Develop methods to predict location and nature of buried ore deposits.

He cited growing markets for beryllium, columbium, selenium, tellurium, and germanium to illustrate his first point; present taconite mineral processing, to illustrate point two; and the use of airborne magnetometers and radiation detectors as examples for point three.

Study of genesis and habits of ores in specific districts, he said, has led to the search for blind orebodies, and "the recent discovery of orebodies beneath a concealed thrust fault in the East Tintic district is a bright example of scientifically guided ore-finding within a known district."

Studies indicate, Nolan said, "that many districts remain to be discovered, perhaps as many as ten times those now known; in addition it suggests that among these undiscovered districts there will be the same relative number of major districts, or "elephants" as have been found up to now."

Thomas B. Upchurch, Washington, D.C., assistant director for procurement of the AEC's division of raw materials, said the Commission staff now was engaged in studies on potential markets for uranium after the 1966 domestic procurement program ends. "To date, the Commission has made no decision as to whether there will be an AEC purchase program" after that date, he said.

The Tacoma copper smelter of the American Smelting & Refining Co. may close down in next several weeks because of a shortage of copper-bearing raw materials.

The reason: Subsidy of copper concentrates imports by Japan which has deprived this smelter of necessary operating feed.

A spokesman for Asarco said that unless the situation is rectified as a result of State Department agreement with the Japanese, the smelter—founded in 1890 and originally employing some 1600 workers—may be closed for good.

While Tacoma is important to the international operations of American Smelting & Refining Co., it also represents to the Intermountain West the only reduction facility open to much of the type of ores and concentrates produced on custom basis in Utah-Idaho-Nevada areas.

Lack of adequate smelter outlet is a definite deterrent to the prospect for and the development of copper-bearing materials. Further, existence of competing domestic copper smelters is essential to maintenance of proper treatment charges for the independent miner. An example of the problem the Tacoma smelter faces is found in the recent development of a 30-million ton 2% grade open pit copper property in British Columbia by Craigmont mining interests.

Almost all of this copper will go across the Pacific for smelting in Japan.

The present and pending close down will be temporary—until sufficient backlogs of concentrates are built up to handle the minimum operating demands of the furnaces. Only 600 smeltermen are currently employed at presently reduced operating rates.

What has happened at Craigmont in Canada also has happened to Asarco contracting for feed materials for the smelter elsewhere. The Japanese are purchasing materials for their smelting industry from Australia and elsewhere in the world in competition with Asarco.

The Asarco spokesman maintains that Tacoma has operated in competition with smelters all over the world in the past—but cannot meet the competition of the internal subsidy which the Japa-

"If we could do as well in the marketplace and in Washington as we're doing in the mine and mill, we'd be in damn' fine shape."

The following is an index to the highlights of the American Mining Congress Meeting, held last month in Seattle. The extracts of the papers and talks given at the AMC annual meeting prove the validity of the above remark, made by one of the audience.

IN THE MARKETPLACE

Jim Boyd calls the recent stability of copper prices "a phenomenon". p 131

Japanese copper ore purchases may force the closing of Asarco's Tacoma smelter. p 126

GE official forecasts a plus-8-million market for U_3O_8 by 1975. p 128

"Industry spends 4% of sales for research; mining spends less than 1%." p 126

—AND IN WASHINGTON

Sam Williston attacks Government inactivity in helping domestic mines and says there will not be a national minerals policy "until the last mine is closed." p 134

AEC and the Congress are seeking a uranium program for post-1966 (126). Mitch Melich blasts BLM official for "writing-off" the uranium industry in a public statement. p 132

Rep. John H. Dent attacked U. S. foreign aid to countries which use it to compete with U. S. industries. "Helping a needy neighbor is charity. It stops being charity when you buy back what you've given him in the first place. It then becomes stupidity . . ." p 133

Gray (133) and Rep. Aspinall attack Wilderness Bill. Aspinall and Mrs. Pfost promise a fight. p 137

Clark Wilson charges "a group of staff members in some administrative agencies" with influencing U. S. mining policy. p 141

Assistant Secretary John Kelly says the Administration will study depressed mining areas to see "what is to be done", but offers no encouragement as to tariff or subsidy relief. p 141

IN THE MINE

Weed Heights has enjoyed remarkable success with its preventive maintenance program, including a shear coupling to protect its truck transmission. p 142

Missouri's state geologist, Thomas Beveridge, outlines the exploration boom which his area is experiencing in iron ore, lead and zinc. p 142

Frank Tippie, Moab resident manager for Texas Gulf's $30-million potash project, outlines production and processing plans. p 145

S. D. Michaelson defines the entrance of new nations into the competitive world as "a second industrial revolution," and calls for more and better cost cutting. p 134

R. K. Barcus calls opening of the new Humphreys phosphate pit in Utah a "radical departure" in development of low-grade deposits. p 137

AND IN THE MILL

Continued progress in the field of direct reduction of iron ore was outlined by two industry experts. p 131

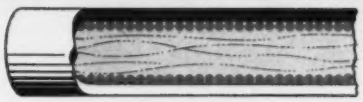
The Copper Queen concentrator is benefiting greatly from installation of new automation and controls at the Bisbee property. p 131

Cyanamid's Pete Cadwell cites the three areas of progress in copper concentration: mechanical, operational and chemical. p 128

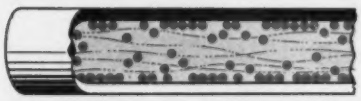
W. R. Van Slyke of Cleveland-Cliffs outlines progress in heavy-media cyclones in iron ore treatment. p 128

LUBE LOGIC

Tips for more efficient equipment performance



Rust inhibited oil protects by "plating" metal surfaces with additive shield.



Adding straight mineral oil disturbs this plating effect.

For best rust protection, don't mix straight mineral oil with additive-type hydraulic oil

When you find it's time to add makeup oil to a hydraulic system filled with rust-inhibited oil, make sure you don't use straight mineral oil as makeup.

Reason why: the rust inhibitors in a fortified oil, such as Regal Oil R&O, prevent rusting by "plating out" on metal surfaces, sealing them against air and moisture. The presence of this film depends on a chemical equilibrium in the oil, and it will give optimum protection only as long as this equilibrium is maintained. If you add straight mineral oil after an original charge of rust-inhibited oil, you'll disturb this chemical balance, and some of the "plated out" inhibitors will go back into the oil. How much "plating" you lose depends on how much straight mineral oil you add, of course, but even a tiny bit of rust can scratch precision pump parts like gravel. So, don't take chances; stick to rust-inhibited oil in your hydraulic systems.

Location of automatic air line oiler determines how well it works

Automatic air line oilers work best when they're located not more than ten feet from the air tool they're lubricating. Some operators put the oiler right at the end of the air pipeline, with up to 50 feet of hose between the oiler and the air tool. That's *not* the way to do it. Automatic oilers operate by spraying a fine oil mist into the air stream. The air will carry the oil just so far, and then the oil begins to hang up inside the hose. The drill gets only a fraction of the oil going into the system, so you use a lot of oil and still get inadequate lubrication.

With only ten feet of hose between the oiler and the drill, the oil can atomize properly but hasn't a chance to hang up inside the hose. Thus you lubricate the drill thoroughly, and use far less oil in the long run.

1. PLAN FOR PROFIT — Texaco's newest color-and-sound movie. Dramatizes the major savings you can make with the proper investment of less than 1% of your total budget — the amount you spend on lubricants. Film features latest lubrication methods and equipment on a number of actual locations, demonstrating the Texaco Simplified Lubrication Plan in action.

2. FUNDAMENTALS OF LUBRICATION — a brand new Texaco color slide film. A clear, concise once-over that defines technical terms like "viscosity" and explains specifically what lubrication is and what it does. This down-to-earth discussion will give the lubrication man a new understanding of the importance of lubrication, and a fresh interest in his work. It's supplemented with a manual that covers the same ground in greater detail.

3. LUBRICATION OF EARTHMOVING EQUIPMENT — a new slide film, in color. A concise, easy-to-understand analysis of proper lubrication of engines, wheel bearings, steering, track rollers, crawler treads, hydraulic equipment, wire rope, open and enclosed gears. Supplemented with a manual that covers the whole field of earthmoving equipment lubrication in further detail.

FOR AN EARLY SHOWING of any one of these films — or all of them — contact your Texaco Representative *now*.

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Every month or so we'll bring you a batch of "sleepers," little angles, so easy to overlook, where big savings in time and money can be made. If Lube Logic doesn't solve your problems, call your local Texaco man. Anytime, all the time, he's your best source of money-saving lubrication ideas. Don't forget that "Lubrication is a major factor in cost control." Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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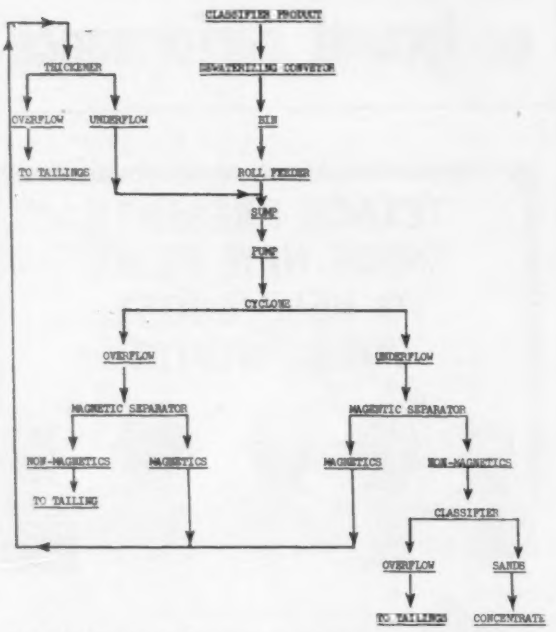
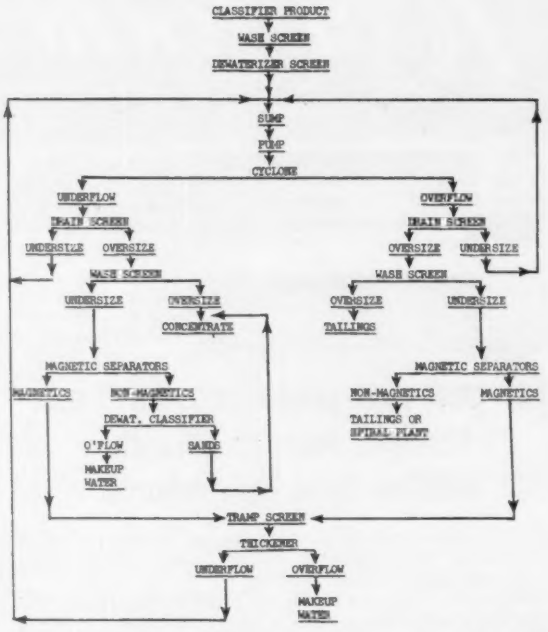




IMPROVED PLANT DESIGN, based on recent progress in the use of cyclones to treat iron ore was presented by W. R. Van Slyke, of Cleveland-Cliffs. (See below.) Mr. Van Slyke illustrated the change by showing an old (left) and new layout.

nese are developing to expand their domestic copper smelting industry.

This industry is protected in Japan by the imposition of a duty of 10% ad valorem on refined copper (equal to more than 3% a lb at today's prices) whereas copper in ores and concentrates are admitted free to Japan. In addition, the Japanese government strictly controls, through licensing, the quantity of refined copper admitted to Japan—as against the free import of ores and concentrates.

In the period 1953-1958, Tacoma smelter produced at a rate of 95,000 tons a year. In 1959-1960, however, as the Japanese became aggressive purchasers of copper raw materials in North America, the output at Tacoma dropped to about 65,000 tons.

Meanwhile, under government sponsorship, Japanese smelter production of copper has increased five times and will be "doubled again" by 1965, said an Asarco spokesman.

Ore Dressing Progress In Cyclone Plants

Progress in the use of heavy-media cyclones in iron ore beneficiation was outlined as follows by W. R. Van Slyke, Range Metallurgist, Cleveland-Cliffs Iron Co.

"Heavy-media cyclones in iron-ore beneficiation usually treat a top size of ⅛-in. to ¼-in. material. The smallest size processed ranges from 28-mesh to 65-mesh, depending on the particular plant in question. Small plants employ finely ground magnetic as a medium in which 1-2% is coarser than 65-mesh, and 50-60% is finer than 325 mesh.

"Crude ore coarser than ⅛-in. to ¼-in. is customarily treated in conventional or static heavy-media plants using ground ferrosilicon as medium. The separation is carried out in drum or spiral-type separators.

"Dynamic type heavy-media separation experiments have also been made on −2-in. + 3/16-in. feed in a 24-in.-dia. cyclone, using a ferrosilicon medium.

"Crude ore, finer than 28 to 65-mesh and coarser than 200 mesh is usually treated in Humphrey spirals or hydrosizers or a combination of both."

The following table shows the increase in the number of heavy-media cyclones operating in Minnesota.

Year	Plants Put in Service	Total Plants Available
1952	1	1
1953	5	6
1954	2	8
1955	2	10
1956	3	13
1957	2	15
1958	1	16
1959	0	16
1960	1	17
1961	2	19

Dr. Lyman R. Fink, general manager of atomic products division of General Electric Co., Palo Alto, Calif., stated that nuclear power generation could by 1975 require as much or more uranium ore than is now in current annual production.

He told AMC that although only a small percentage of uranium production now goes for fuel to nuclear power plants, the potential commercial market could be as great, or greater, than presently exists for nuclear weapons.

The U.S. uranium industry, he said, currently produces about 8-million tons of ore annually for the Government under contracts due to expire in 1966. Less than 5% of this output is used in electrical power generation at present.

He said that both the uranium producers and the nuclear power industry must work together to cut costs of atomic-electric power.

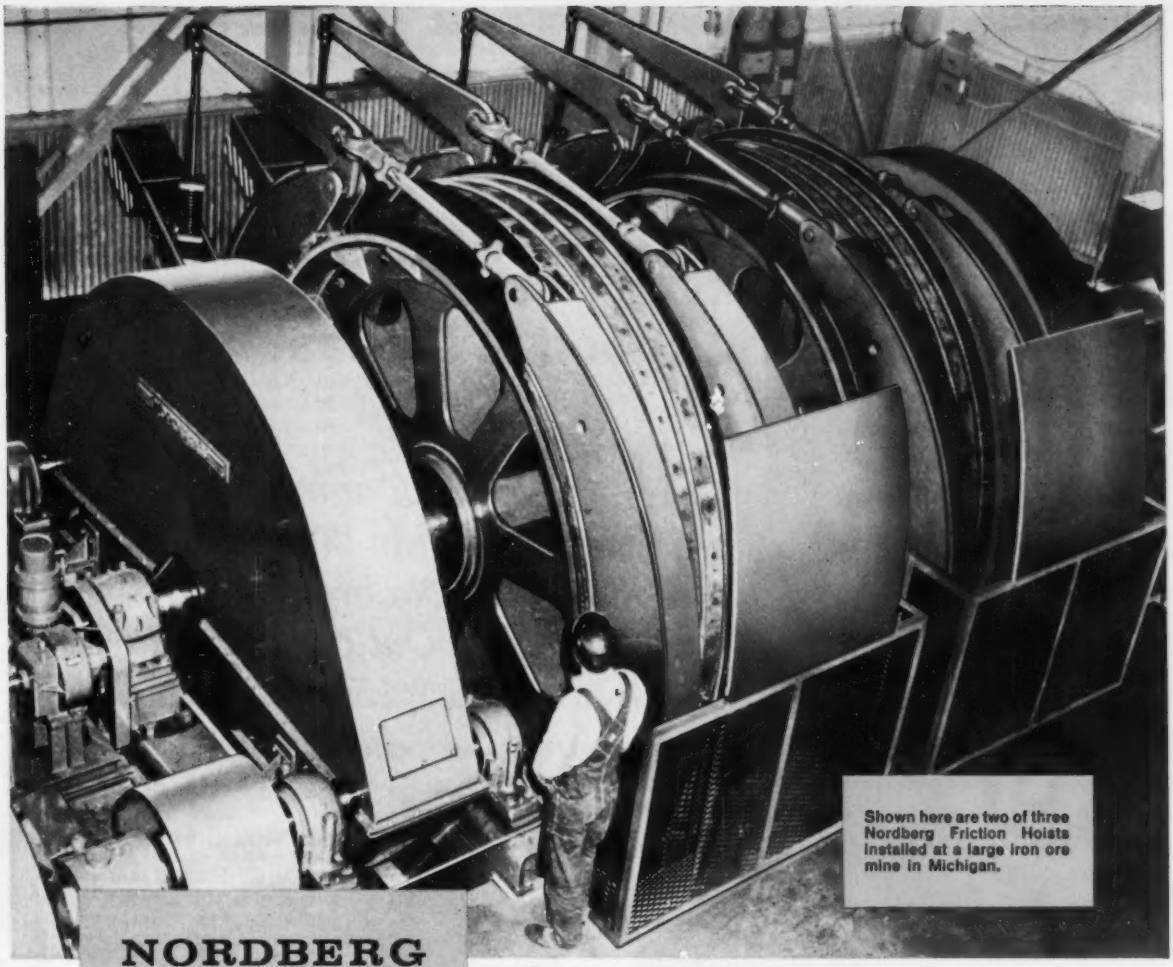
He said a 15% (one mill/kwhr) cut in cost of atomic-electric power in the next few years could mean the difference between 10-million and 30-million killowatts of installed nuclear capacity by 1975.

He also warned that the survival of uranium mining and milling after 1966 "may depend on how successfully the uranium raw materials industry performs as a commercial enterprise in open competition with other energy sources for the power market."

Recent Advances in Copper Concentration

The three areas in which progress has been made in copper concentration were mechanical, operational and chemical, according to E. P. Cadwell, chief metallurgist, Mining Chemicals Department, American Cyanamid Co.

Under mechanical advances he cited the use of larger diameter mills for finer grinding and increased capacity; and cyclone separators to replace conventional classifiers and save floor space. He noted that flotation cells have changed but



Shown here are two of three Nordberg Friction Hoists installed at a large iron ore mine in Michigan.

NORDBERG Friction Type MINE HOISTS

. . . used for economical SERVICE and PRODUCTION HOISTING

Where applicable, service or production hoisting can be economically handled with Nordberg Friction Type Mine Hoists . . . built for either counterweighted or in-balance operation, geared or first motion electric drive, manual and/or fully automatic control.

Outstanding features of the Nordberg design include: one-piece welded steel drum; anti-friction roller bearings throughout; a choice of pressure applied—pressure released or gravity applied—pressure released brakes, all with emergency gravity back-up.

In addition to friction types, Nordberg *Drum Hoists* are in wide usage throughout the world; are available with manual, push-button semi-automatic, or fully automatic control.

It will pay you to let Nordberg's 65 years of specialized mine hoist experience help you select the right type and size hoist to best meet your specific needs.

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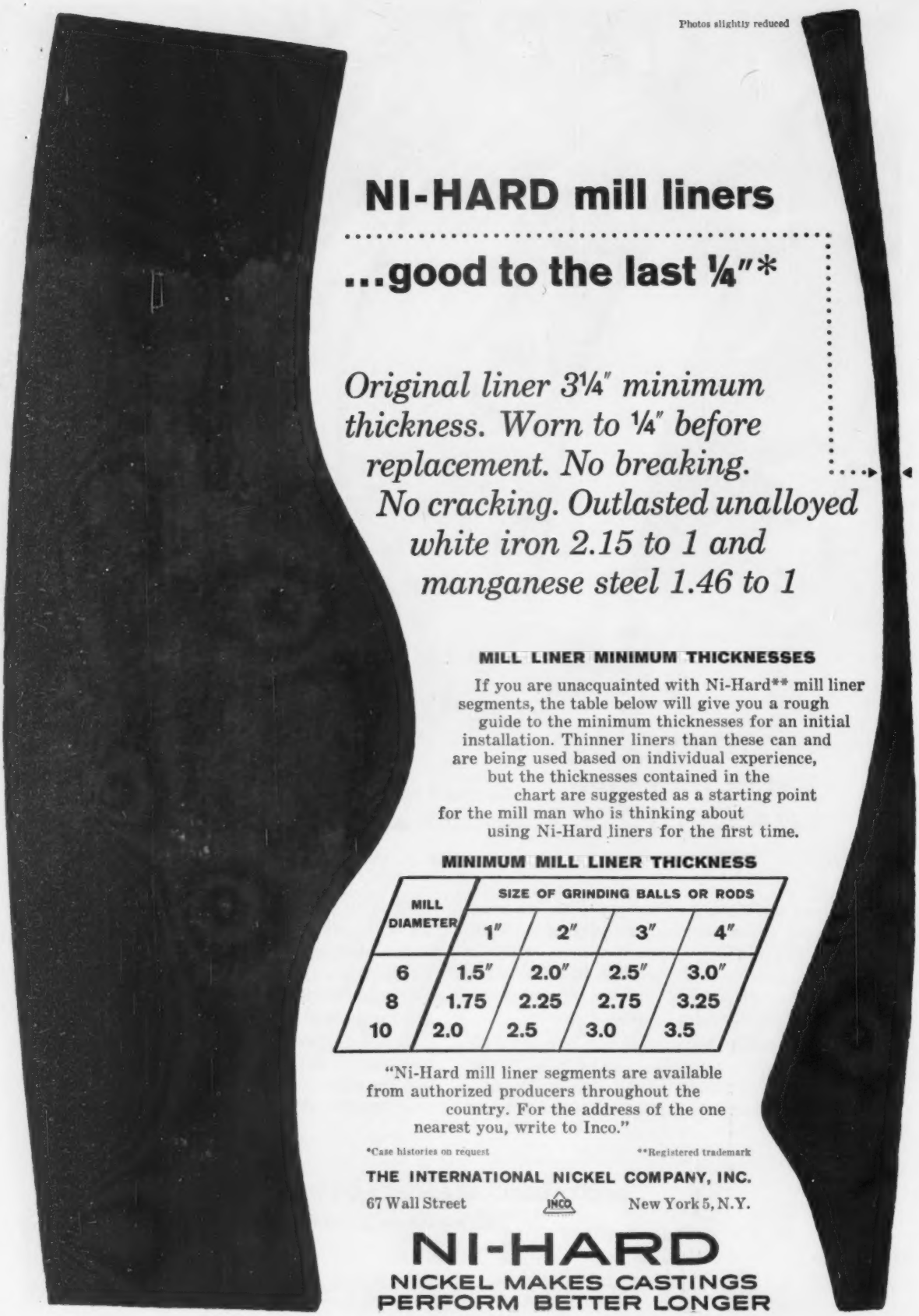

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Original liner 3¼" minimum thickness. Worn to ¼" before replacement. No breaking. No cracking. Outlasted unalloyed white iron 2.15 to 1 and manganese steel 1.46 to 1

MILL LINER MINIMUM THICKNESSES

If you are unacquainted with Ni-Hard** mill liner segments, the table below will give you a rough guide to the minimum thicknesses for an initial installation. Thinner liners than these can and are being used based on individual experience, but the thicknesses contained in the chart are suggested as a starting point for the mill man who is thinking about using Ni-Hard liners for the first time.

MINIMUM MILL LINER THICKNESS

MILL DIAMETER	SIZE OF GRINDING BALLS OR RODS			
	1"	2"	3"	4"
6	1.5"	2.0"	2.5"	3.0"
8	1.75	2.25	2.75	3.25
10	2.0	2.5	3.0	3.5

"Ni-Hard mill liner segments are available from authorized producers throughout the country. For the address of the one nearest you, write to Inco."

*Case histories on request **Registered trademark

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NI-HARD

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

little, and the battle has narrowed to about three types of cells. Thickening and filtration mechanically have not undergone great changes, Cadwell noted, but the chemical industry has been active in developing both filter aids and flocculants to augment capacities of existing machines.

In operational advancement, Cadwell mentioned tendency toward bulk flotation with selective depressants, more accurate pH control equipment, and more accurate reagent feeding devices. He predicted greater use of X-ray analyses equipment which he said offers recovery of the highest level and the elimination of fluctuations "before they become history." Programming of metallurgical processes in concentration will lead ultimately to control by computers, he said.

Under chemical advances, he mentioned use of flocculants for water clarification and filter aids; higher selectivity in reagents used in cleaner circuits to produce higher grade concentrates.

Cadwell concluded by showing color slides for four operating copper deposits together with tables of mineralogical analysis. These, he explained, show the maximum theoretical grade of concentrates for each mine versus the concentrate which is currently being produced. The microscopic color slides clearly showed in some cases that a finer grind was required while in other ores, grinding merely increases the problem.

James Boyd, president of Copper Range Co., Boston, Mass., and former director of the United States Bureau of Mines, said that stability of copper prices in the last two years has been a phenomenon.

Studies now show that when copper hits 35¢ a lb consumers begin hunting for substitutes. When it is below 30¢ a pound, availability is impaired as higher cost producers are forced to cease operations, he said.

In last 10 years, United States share of world consumption has dropped from 51% to 31% while the U.S. share of world production has declined from 36- to about 28%, he said.

The cause: higher production in other nations and much higher consumption in Europe and Japan.

Richard M. Foose, chairman of the department of earth sciences of Stanford Research Institute, Menlo Park, Calif., said that in addition to the "frenetic activity" by Texas Gulf Sulphur Co. and Superior Oil Company of California in the Utah potash fields, Armour Agricultural Chemical Co. in joint venture with Pittsburgh Plate Glass will seek to mine potash by circulating fluids into the deposits. The potash would then be carried across the Great Plains by pipeline to Great Lake ports. "Pending the possible success of this venture, as many as a dozen other major corporations may step into the Saskatchewan potash race," he said.

Direct Reduction By the H-Iron Process

The H-Iron process which involves the direct reduction of fine iron ore with hydrogen in fluidized beds at temperatures below 1000F, and a pressure above 200 psi was described by R. J. MacMullan, vice-president, and C. A. Johnson, director of research, Hydrocarbon Research, Inc.

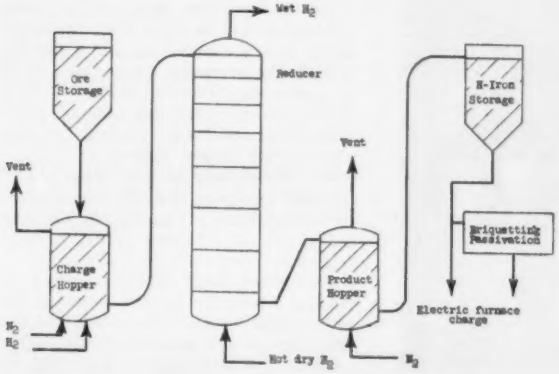
Two commercial plants have been built: A 50-tpd unit operated by Alan Wood Steel Co. (See E&MJ, December 1959); and a demonstration plant of 110-tpd design capacity at the Vernon works of the Bethlehem Steel Co., Pacific Coast Works in Los Angeles. The product of the plant is used as melting stock in Bethlehem's electric steel making furnaces. Bethlehem has announced successful completion of its experimental H-Iron program. During the final phase of the program, the plant produced 120 tpd of 95% reduced powder.

Automation and Control At the Copper Queen

Instrumentation and control equipment for the following installations at the Copper Queen concentrator, Bisbee, Ariz., were described by Philip Allen, mill superintendent, Phelps Dodge Corp.:

1. Dumping control devices at the primary crusher.
2. Closed circuit television.
3. Automatic tripper car.
4. Pulse-feeding of reagents.

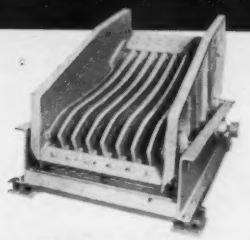
New feed is brought to the 48-in gyratory crushers in 25-ton or 35-ton trucks. Traffic signals at either end of the crusher building control dumping.



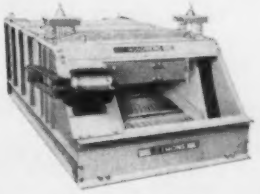
IRON ORE by direct reduction is being accomplished in two U.S. plants (see above).

SYMONS® SCREENS

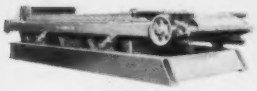
CUT COSTS IN MINING SERVICE



Vibrating Bar Grizzly
For rugged duty, large capacity scalping where clear spacings of 2" and larger are desired.



Rod Grizzly and Rod Deck Screens
Ideal for moist and sticky materials. Very high capacity results from multiple varying deck action and screen deck utilizing individually replaceable spring steel rods.



Horizontal Vibrating Screens
Due to its positive screening action, the Symons Type F Horizontal Screen can make numerous separations at high capacity with less screening area required.

Write for bulletins.

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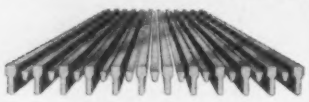
Kleenslot

PREPARATION SCREENS

designed for vibrators or stationary applications —for dewatering, screening, washing, extracting, filtering or sizing

T-WEDGE KLEENSLOT



A new concept in guard bar design. T-shaped wire replaces typical "bar" to increase screening surface while keeping large unscreenable lumps of material above the tolerance governing lower screening surface.

F217 and F250 KLEENSLOT

Large size wires maintain maximum efficiency over an extended period in abrasive applications.

Although large in wire size, this screen will maintain openings as close as 1 m.m.

"S" KLEENSLOT

For applications where screening out of flats or slivers is of prime consideration. Also furnished in a "C" bend. Recommended for applications requiring openings larger than 1 m.m.

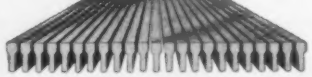
MARCEL

This screen, while screening out "slivers," presents a flat surface for materials to wipe the opening clean Available with openings up to 1 m.m.—for larger opening see "S" screens.

SCREEN GUARD

Vertical guard bars keep larger unscreenable materials above the actual screening surface. This increases screen life and promotes much greater efficiency in dewatering.

G187 and GB187 MIGH-TEE KLEENSLOT



Special profile increases wearing surface. This is a heavy duty precision type screen that will easily maintain openings smaller than ⅛ m.m. and openings larger than ordinarily considered economical.

TAPER-SLOT

From loop to loop, the screen opening gradually increases. This design is to eliminate blinding when screening large amounts of near-opening size materials. For example: .016 opening tapered to .024—the combination of opening sizes would be the same between each loop throughout the entire screen.

Wedge-Wire Kleenslot Screens are custom manufactured to your application and are available in many sizes, spacings and finishes. Our engineering staff will assist you capably and promptly in obtaining the proper screen for highest production at lowest cost.

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Red, green or amber lights tell the driver when he is to back into dumping position, elevate the truck bed, or to remain away from dumping stations. Photo-electric cells and sirens are installed to assure positive and safe performance.

Closed-circuit television is installed to watch for belt damage and gage height of ore in the coarse ore bin. Control instrumentation has eliminated the need for three men formerly assigned to check these points.

With a system of signals and lights the automatic car tripper performs these functions:

1. Low point in bin as shown by amber light causes tripper to stop for about one minute before continuing forward progress. This enables low points to regain their elevation with the rest of the bin.
2. The tripper automatically reverses when it reaches the end of its traverse, or it contacts a high spot.
3. When any of the transfer points plug off, all belts between coarse ore bin or fine ore bin stop until the obstruction is cleared.
4. If ore backs up into tripper car discharge chute, all belts stop.
5. Whenever tripper stops for any irregularity a siren sounds until trouble is cleared.

Pulse feeding of reagents is best where the reagent has had adequate mixing and conditioning prior to entering the flotation circuit. Feeding reagents in ball mills is the best application. Where there are four or more mills, the ganging of four feeders to one timer facilitates the changing of reagent feed rates. Measurement of feed rates is a simple matter since it involves the measurement of but one pulse and multiplying by the number of pulses per minute.

Mitchell Melich, Moab, Utah, spokesman at AMC for the industry, expressed confidence that the Government would not in the national interest leave the uranium industry and the atomic energy program in a "no man's land" after expiration of the 1966 domestic procurement program.

He did take occasion to blast a spokesman for the U.S. Department of Interior who earlier stated boldly that if someone found a "mountain of uranium today" he couldn't sell it. The official, Karl Landstrom, head of the Bureau of Land Management, also said a future market was not in sight. The implication of his remarks is that the BLM will not henceforth recognize a uranium claim as containing "valuable mineral". This, if true, would rouse all sorts of problems connected with prospect for uranium in the United States.

Mr. Melich said he was "shocked and amazed" to learn that the Department of Interior had "written off the uranium industry." He termed the assertion "stupid."

The metal ranks third in value of mineral production in Utah—next to oil and copper. Mr. Melich noted that the total domestic uranium industry today employs 200,000 persons and that in

the last 11 years Congress has appropriated $27-billion for atomic energy.

AEC alone employs 6500 persons. "I do not believe the Government can afford to let the uranium industry go the way of the tungsten, manganese, fluorspar and other minerals—all of which ended dismally under Government plans."

Rep. John H. Dent, Pennsylvania Democrat and former labor leader, told delegates the United States is becoming a backward nation itself as a result of foreign aid programs.

The sponsor of the so-called "Dent Amendment" in Congress told the American Mining Congress convention at Seattle that this nation should follow the principle that "Americans should not be taxed to put themselves out of business, out of jobs and into industrial oblivion."

His amendment provides that foreign aid funds will not go to build up facilities for production of goods that will be imported at low cost into the United States to the detriment of the American working man.

"We aren't stopping aid to needy peoples, we are trying to stop exploitation of underprivileged peoples who are forced to work for as low as 5c an hour under improper conditions so that a few families and officials can get rich by shipping their low cost items into the American market at fabulous profits . . ."

"Helping a needy neighbor is charity. It stops being charity when you buy back from that neighbor something you've given him in the first place. It then becomes stupidity," he declared.

Rep. Dent told the miners that "as chairman of the committee studying the effects of imports and exports upon American unemployment, I can assure you that this nation is in deep, serious trouble unless we put more hard, common sense and less theoretical planning into our 'trade and aid' deals."

Congressman Dent is chairman of a House labor subcommittee investigating the effects of imports on unemployment.

The U.S. mining industry was called upon to "marshal an army" to defeat wilderness legislation in the House of Representatives next year. The appeal came from W. Howard Gray, Reno.

But Assistant Secretary of Interior, John Carver, advised the miners their "unyielding opposition to a wilderness bill on the ground it is an infringement upon a precious right of old prospectors to ply their romantic trade . . . is in my view shortsighted and of debatable wisdom."

Mr. Gray, who has represented Nevada Mines Division of the Kennecott Copper Corp. on many occasions—as well as the American Mining Congress—asserted the legislation denies the prospector effective entry in the proposed wilderness area.

This is the primary reason for opposition of the western mining industry to the legislation, he asserted.

Mr. Gray reiterated the belief of the minerals industry group in multiple use of the public domain.

all the features that mean
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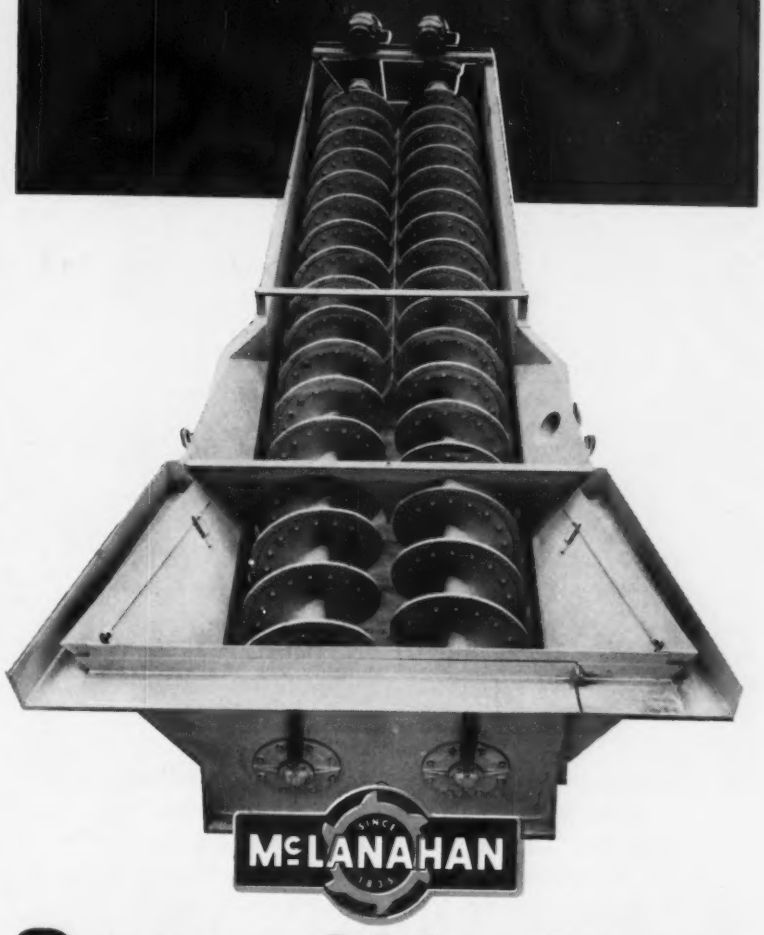

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Garn Moody has capitalized on his working knowledge of heavy equipment to branch out into a number of successful business operations. From his initial start in contracting, he has put his reliable spread of used Cat-built equipment to work in the non-allied fields of farming and, since late 1958, a thriving strip-mining operation in the rugged country near Delta, Utah.

"When you're moving into an unfamiliar new field, you've got to have smart crews and dependable equipment," says Garn Moody. "My used Cat-built rigs have always given me good steady production. We've worked our two D8s and two DW20s 8 to 10 hours a day since we bought them two years ago. The work is rough, but down time has been light."

Garn has purchased all three types of used equipment his Caterpillar Dealer offers: Bonded Buy, Certified Buy and Buy and Try. "In each case," he says, "the deal worked out fine for me. I'll buy under the same contracts any time. Dependability from Bonded Buy machines is like buying a new machine."

Success is never a sure thing, but if you're expanding your operations and trying to keep your equipment outlay on a budget basis—without sacrificing reliability—check your Caterpillar Dealer's protected purchase plans.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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BEST BUYS IN NEW AND USED EQUIPMENT

S. H. Williston, executive vice president of the Cordero Mining Co., Palo Alto, Calif., said there wouldn't be any national minerals policy from Washington "until the last mine is closed."

He said that "There is one thing the industry has learned, however.

"It is that although the Department of Interior, the Office of Mineral Mobilization and the (former) Office of Civil and Defense Mobilization are supposed to have the authority to maintain a mobilization base in strategic and critical metals, they do not, in fact, have any effective power to aid or maintain a domestic industry.

"The mineral policy of the United States is made by the State Department without the slightest consideration for civilian and defense requirements of this country or for the maintenance of a domestic mineral economy," Mr. Williston said.

He noted that "it seemed impossible a year ago for the situation in the strategic metals field to get worse than it was. But it has."

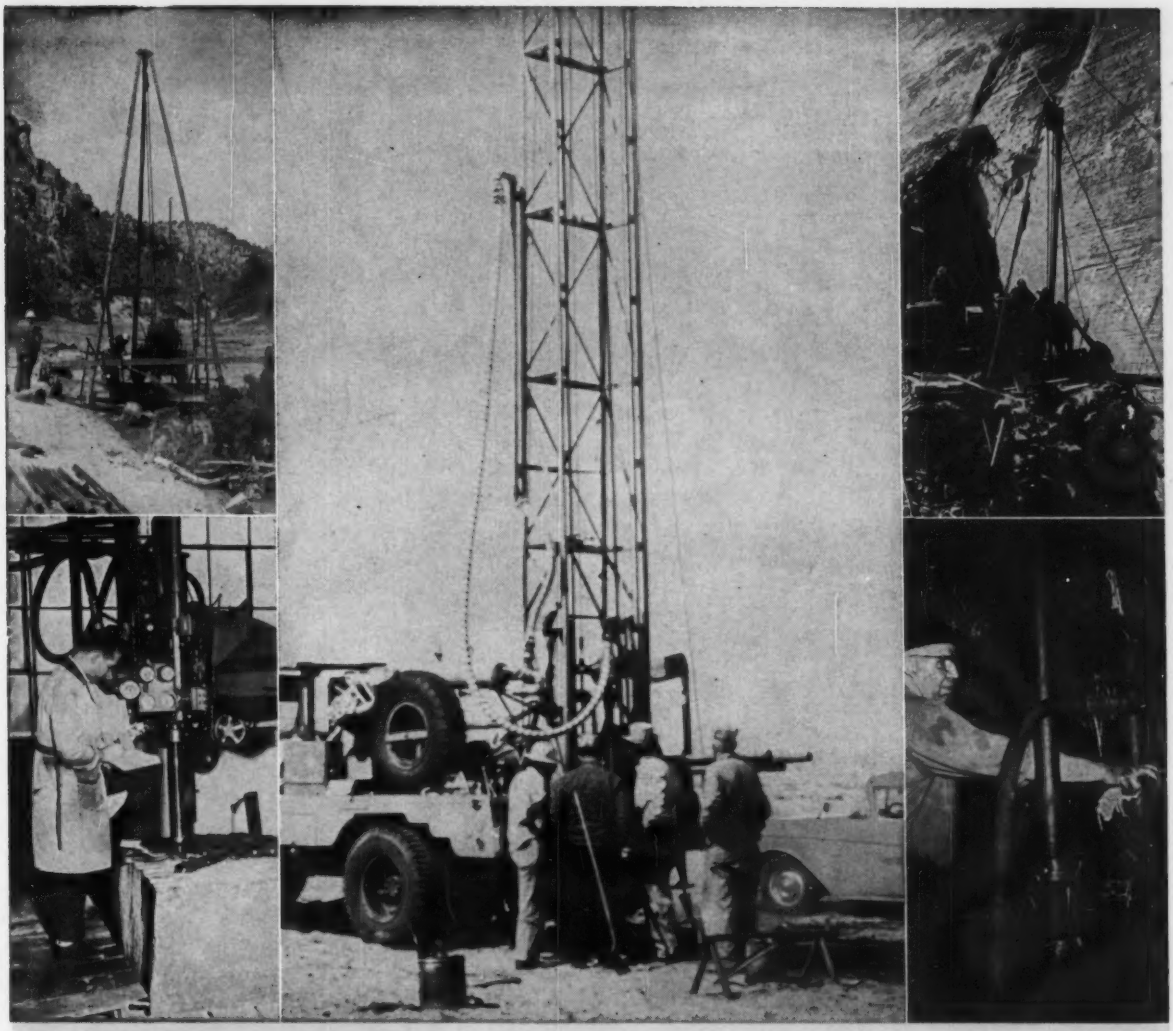
Michaelson Urges Economies

Mining management can improve their internal positions whether government takes favorable action or not on major problems affecting them, according to two authors.

S. D. Michaelson, chief engineer of western mining divisions and S. R. Zimmerley, director of research, Kennecott Copper Corp., said that the world was now in first phase of what will be a second industrial revolution. "The increasing industrialization of formerly backward countries plus the impact of mechanization everywhere—along with market competition of high-quality, substitute materials—are creating serious problems of maintaining profits or even staying in business, much less make a profit," he said.

The paper, presented by Mr. Michaelson, brought out various methods of reducing costs, citing one case where work simplification programs had saved

S. D. MICHAELSON of Kennecott's Western Mining Division was a co-author of a paper on the "second industrial revolution" with Dr. Stuart R. Zimmerley.



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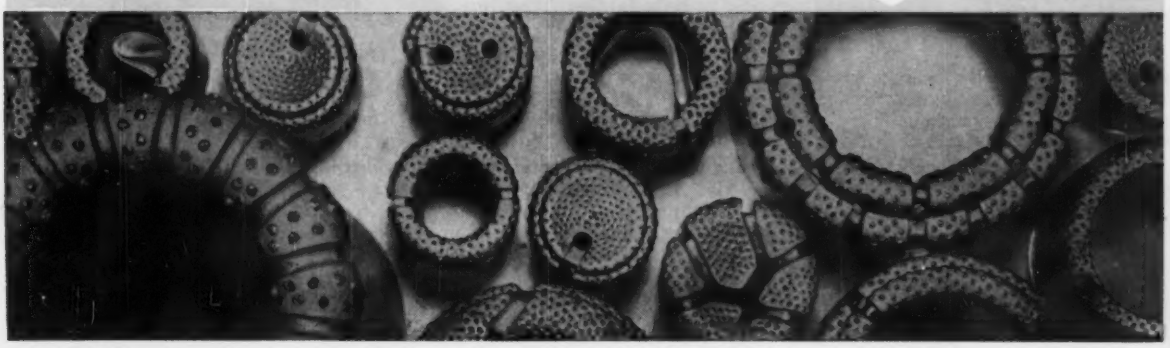

6 or 8-yd. Lima Type 2400 Shovel, shown on a stripping operation in Pennsylvania.

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Limas are job-designed and built from the ground up for high output stripping and loading. They remove overburden fast and easy for high-speed loading of coal and ore. These are some of the reasons Lima's big, bold Type 2400 is a high-production mining favorite everywhere:

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one firm alone $2 million a year.

Waste dump leaching, mining research aimed at steeper pit walls and cuts in waste removal problems; drilling fewer holes in exploration for ore bodies; automation of metallurgical processes were reviewed.

R. K. Barcus, assistant general manager of San Francisco Chemical Co., Montpelier, Ida., said that the opening up of the new Humphreys phosphate pit north of Vernal, Utah, represents a "radical departure" in development of low-grade phosphate resources in the United States.

"Cheap, bulk mining of a relatively thick section and subsequent beneficiation of all the rock are the foundations upon which the development is based," he said.

"It seems reasonable to compare this departure with the large low-grade porphyry coppers that have superseded the high grade and high cost copper deposits of the older camps," he said.

Rep. Wayne Aspinall, chairman of the powerful House Interior Committee which must be cleared before the House can concur in Senate passage of the wilderness legislation, also plugged for the multiple use concept.

The Colorado Democrat was not present at the AMC meeting because of rapidly approaching adjournment of Congress. But he declared in a statement to the convention that:

"If multiple use means allowing more than just a single use of an area . . . or permitting many uses at one and the same time, I can assure you not only of my support, but of the support and endorsement of the members of the committee of which I am chairman."

Secretary Carver's apparent view, however, is that the conflict stems from desire to use lands for economic gain as against a "continuing need for conservation management."

He said that "multiple use" was not a "truly descriptive word," and announced that even a high school student knows that two bodies cannot occupy the same space at the same time.

"You simply cannot put a mule, a miner and a picknicker on the same square foot of ground—unless it's a case of a mule-headed miner on a picnic," Mr. Carver said.

The assistant secretary is a former administrative aid to U.S. Sen. Frank Church, (D. Ida.), prominent sponsor of wilderness legislation in the Senate.

Secretary Carver asserted it was "authentic westerners" who carried the wilderness legislation to victory in the United States Senate, noting that only four westerners voted "no."

But there remains a strong chance that the wilderness legislation won't even be voted on by the members of the House of Representatives in 1962—an election year, incidentally.

Rep. Aspinall has informed Rep. Gracie Pfost (D. Ida.) that he wants the Pfost subcommittee of the House Interior Committee to conduct "extensive hearings" on the wilderness legislation next year.

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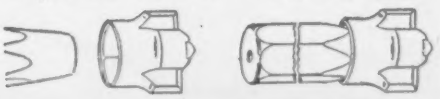

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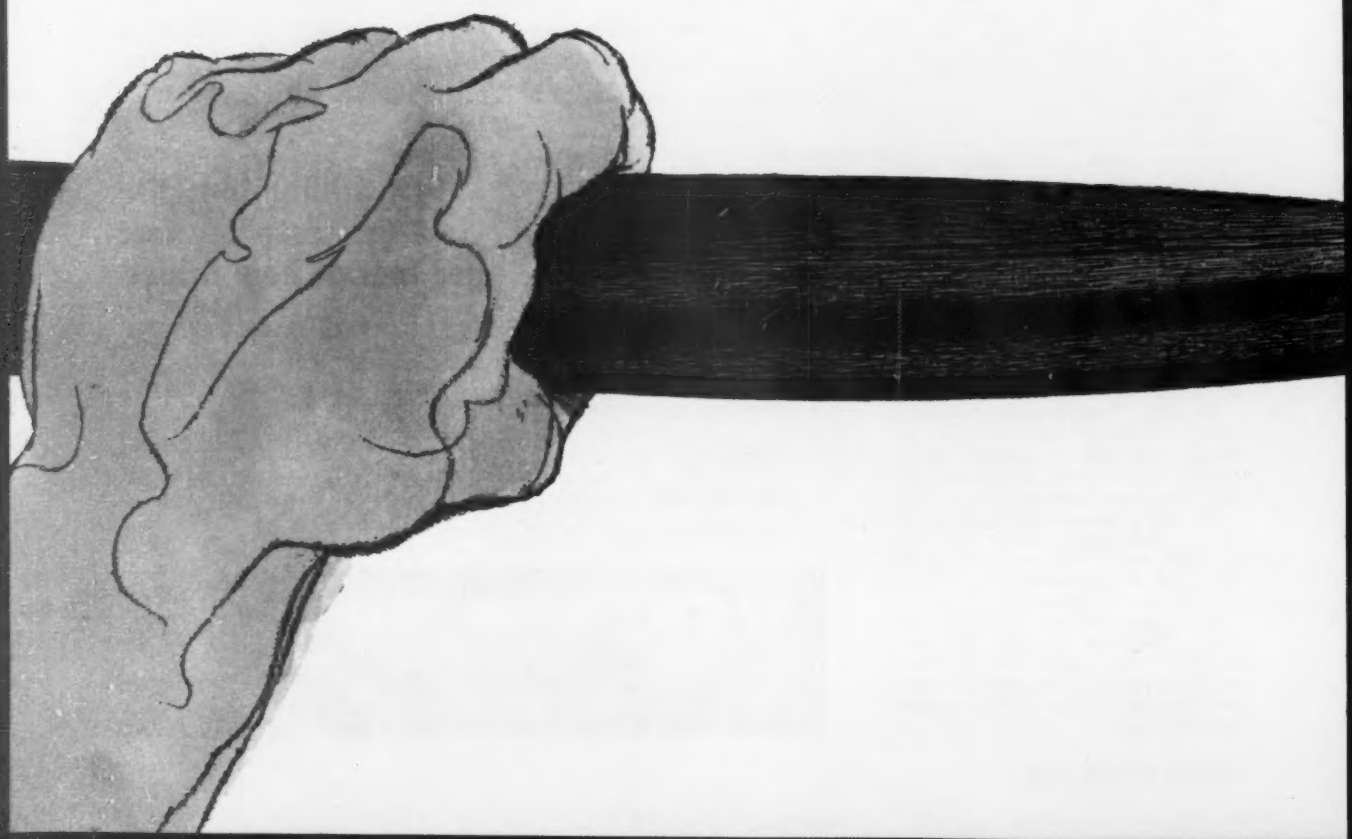

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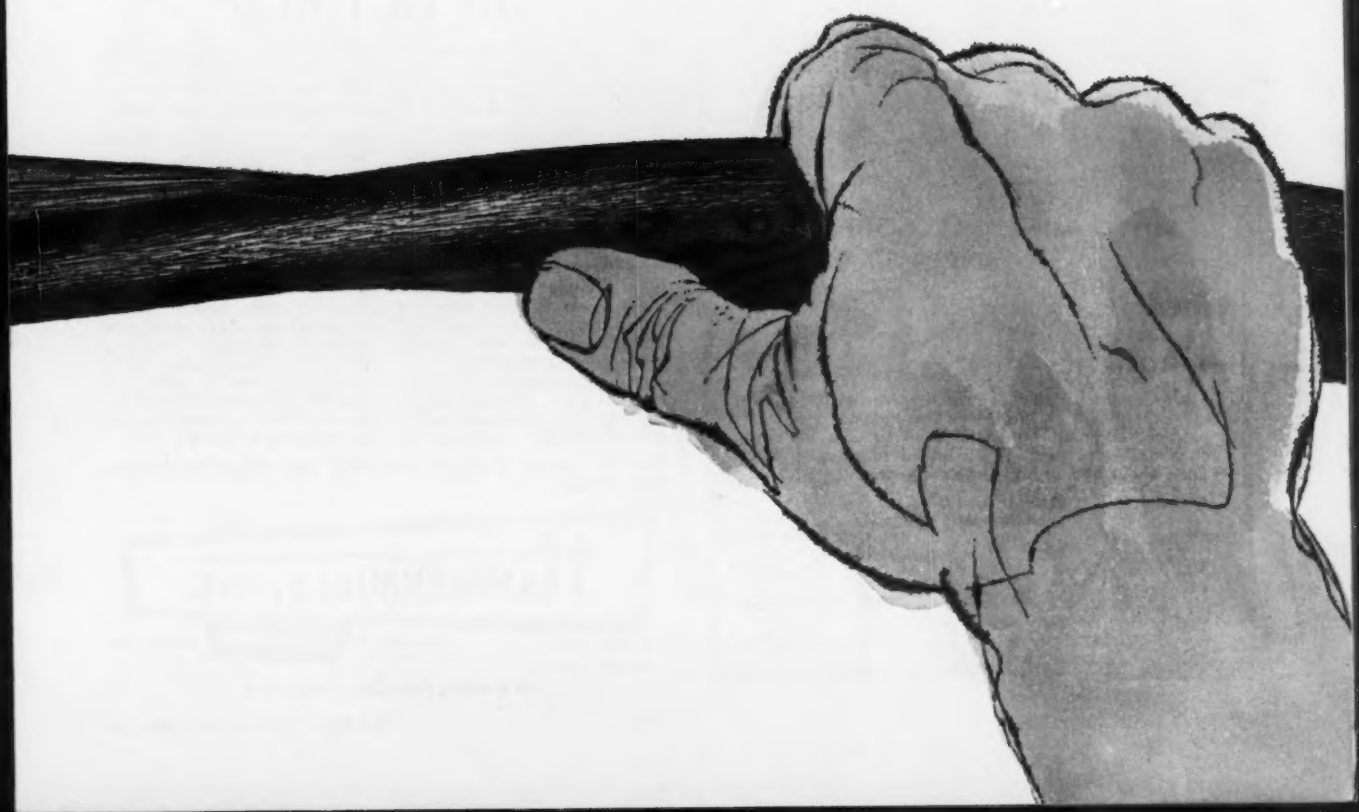

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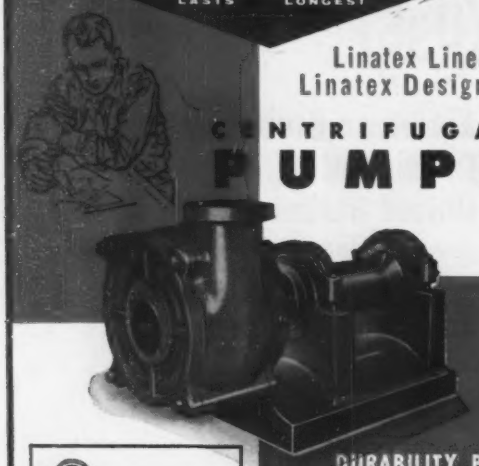

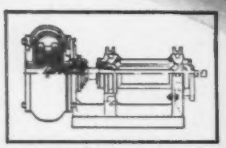

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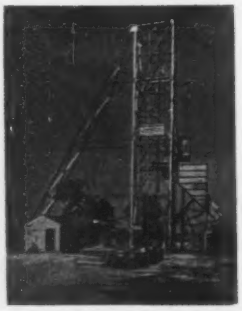

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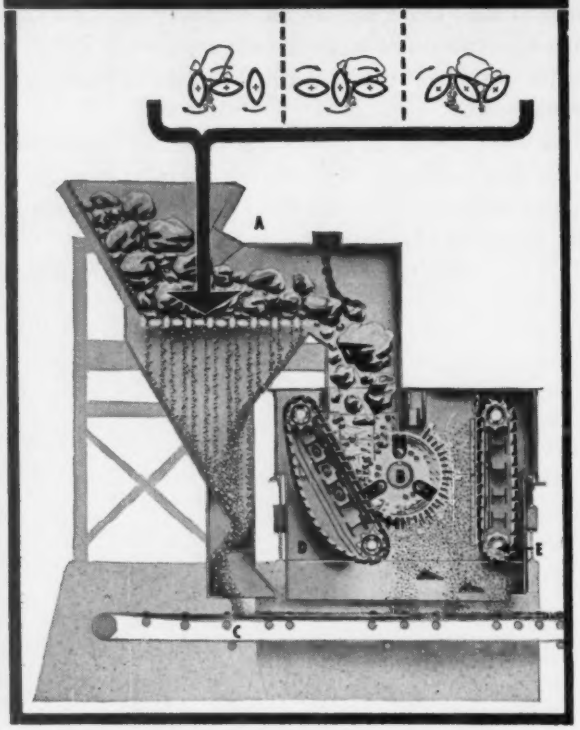

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Since the Wobbler Feeder sends only oversize to the Bulldog Hammermill, the Bulldog can handle more material per day. Add this efficient, no-waste breaking power to the double, non-clog protection of this new combination and you can increase your production up to as much as 100%!

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These hearings will be held by the subcommittee in western communities.

Rep. Aspinall said in his statement, "I believe that the adoption of a permanent multiple use policy is the essential cornerstone of good public land management. Then, unless Congress (and not the executive department) determines it to be in the national interest for a particular area to be designated for specified use, all lands will be available for grazing, mining, watershed, timber and recreation, or fish and wildlife development."

The western Coloradoan also is sponsor of legislation in Congress which would require the Secretary of Interior to apply the "principles of multiple use and sustained yield management . . . as a policy for lands of the national forest."

The Pfost subcommittee will start its hearings in Idaho on Oct. 30—probably either in the Couer d'Alene area or the Salmon River region.

The Congressional group will spend the night of Oct. 31 in Salt Lake City and depart the next day for Grand Junction, Colo. for a hearing on Nov. 1 at Montrose, Colo.

From there on, it will conduct hearings in Arizona and in California.

The results of these hearings will then be studied by the group.

During 1962. additional hearings will be conducted in Washington, and the full committee also will conduct its hearings.

Clark L. Wilson, the former Salt Laker who is chairman of the Emergency Lead and Zinc Committee, said that this industry "entered the new year with a new Administration and new officials—and with high hopes for announcement at long last of a constructive long-range minerals program. To date, this has been a rehash of old ideas."

He said that in conversations with State Department officials, they will look you in the eye and announce that domestic lead and zinc mines are being phased out. And they'll smile when they tell it to you. "Missouri can take care of all the U.S. lead production and Tennessee, the zinc production," they say, Mr. Wilson reported.

R. L. McCann, New York City, president of the New Jersey Zinc Co. said "phase out" was a new term now in Washington for the minerals industry. "It hasn't anything to do with timbering a mine. It requires no brains to exercise it. What they really mean is that we are being subjected to the Governmental gas chamber. What we're looking for (in Washington) is a fair share of common sense," he said.

Mr. Wilson said there was a "small, hard core" of determined men representing 1% of the zinc industry who are effectively opposing the needs of 99% of the domestic producers.

"I might add that we have no trouble with Congress. It is a group of staff members in some administrative agencies who are influencing policy," he said.

He warned the miners that unless they brought effective pressure to bear upon the Administration, the plight of the lead and zinc producers would worsen.

The Administration will launch "several task forces" to depressed mining areas within the next few weeks to "develop proposals on what is to be done," John M. Kelly, assistant secretary of the U.S. Department of Interior told the AMC.

He said the visitations would be in areas of declining output of mines smelters and where communities are, as a result, in economic difficulty.

Park City, Utah, has been mentioned

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Coppus Blowers for mine ventilation include the centrifugal VENTAIR for long pipe lines and the propeller-type VANO for shorter lines. For a given power consumption both deliver from 30% to 100% more air than an ordinary fan.

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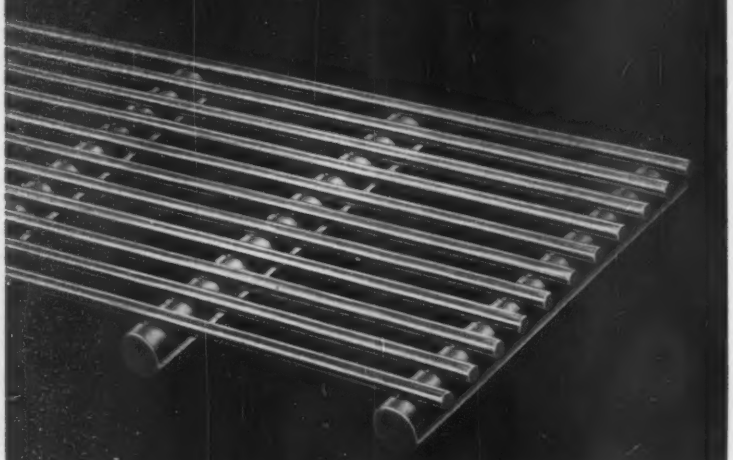

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as one of the areas of visitation, Butte, Mont., certainly will be another.

Mr. Kelly said that the job of the task forces will "not be merely to verify what is already widely known, but to find what is happening to mining generally, to exploration and development and to investments, to confer with leaders and to begin to develop some proposals as to what might be done."

He said the department would "like to provide some special services to small and independent mines. Some of them do not have mills or smelters accessible to them and transportation costs may be prohibitive." In some mining areas, he said, the department will "join with other groups sponsored by the new area redevelopment administration to see what new economic activity may be introduced into depressed mining communities."

The Assistant Secretary for Minerals offered the miners absolutely no encouragement insofar as tariff or even subsidy relief for them was concerned.

"Minerals policies tend to flow from policies which go far beyond boundaries of a mining district; in fact, beyond the boundaries of the nation," Mr. Kelly told the domestic miners.

Earlier, he had told the AMC delegates that "nearly half of all direct investments overseas by United States citizens is in petroleum and mining. American companies are large producers of copper in Peru, Chile and Central Africa; of lead and zinc in Mexico, Peru, Australia and South Africa; of iron in Venezuela, Canada and Liberia. These overseas investments of American companies increase the competition which domestic mining experiences in the United States market," he said.

Preventive Maintenance At Weed Heights

In a discussion of the preventive maintenance program, A. E. Millar, General Manager, The Anaconda Co., Weed Heights, Nev., mentioned that the company is experimenting with a shear coupling installed in the drive line of haulage trucks immediately behind the transmission. This coupling is so designed that the bolts in the shear coupling will break before any damage might result to the transmission itself. No matter how good we consider the drivers, Millar said, we do find that when using the reverse gear, the drivers are not too careful. This adds considerably to the repair problems for transmissions. The six units on which this shear coupling have been installed have been completely satisfactory, and they will be installed on all haulage trucks.

Missouri Boom

Missouri is the scene of one of the most intensified exploration booms in the U.S. Details were revealed by Thomas Beveridge, State Geologist, Missouri Geological Survey, Rolla, Missouri. His paper "Current Mineral Exploration in Missouri" is abstracted in part as follows.

At the present, Missouri is enjoying the most intensive and extensive mineral

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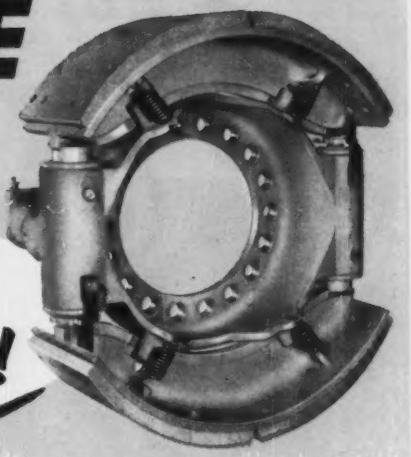

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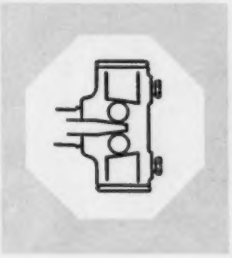

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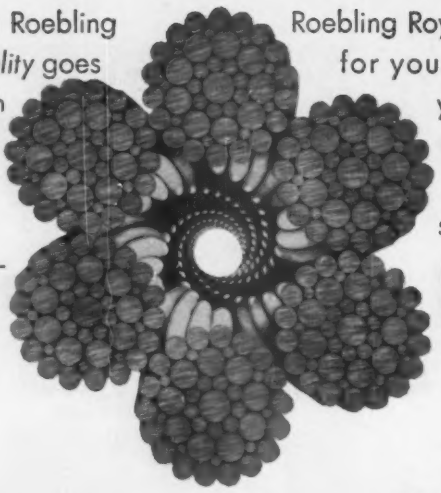

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exploration it has ever seen. At least 16 major metal mining companies are spending millions of dollars annually in the state on exploration which involves a considerable amount of deep drilling and attempts to use all the geologic tools available. Of these 16 companies, 14 are concentrating their efforts in the southeastern quarter of the state. Approximately 50 geologists are working with these companies in the search for minerals in the state. The presence of so many geologists is encouraging because it demonstrates the shift from the older hit-or-miss and hunch exploration to scientifically planned programs.

The most extensive exploration is in the southeastern quarter of Missouri, an area bounded on the north by Sullivan, on the southwest by Eminence, and on the east by the world-famous Lead Belt which includes the town of Bonne Terre, Farmington, and Fredericktown.

Utah Potash Grows

Texas Gulf Sulphur Co. is now below 330 ft in sinking of its 22-ft wide, concrete-lined shaft at Cane Creek, Utah, potash project.

Contractor Harrison International is reportedly aiming at establishment of a record sinking pace for the project. Work, now on two shifts a day, will go onto three shifts later.

A description of the $30-million project was made at technical sessions of the American Mining Congress meeting by Frank Tippie, resident manager at Moab for TGS.

He disclosed that benefication unit being constructed by Stearns Roger Manufacturing Co. will have initial 8,000 tpd capacity to be expanded to 12,000 tons a day.

Mr. Tippie said that one of the major problems in developing the Cane Creek reserve in the gorge of the Colorado River south of Moab has been access. He noted that if construction schedules are maintained Texas Gulf Sulphur Co., nation's largest producer of sulphur, will complete its diversification into potash in late 1962 and will be "able to enter the 1962-1963 fertilizer year with product.

"By the end of the 1964-1965 fertilizer year, we expect to be producing at the rate of 1.1-million tons of muriate of potash annually," Mr. Tippie said. Dr. C. F. Fogarty, Rye, New York, participated in the preparation of the paper with Mr. Tippie. Dr. Fogarty is senior vice president of TGS.

Montana Studies Electro-Thermal Breaking

A RESEARCH PROJECT whose goal is to break rocks by direct application of electrical force is being conducted by Montana School of Mines and Westinghouse Corp. under a research grant from Anaconda Co. General Electric Co. is working on a similar project.

A nonuniform electric field is created between two point electrodes at either end of a rock when a voltage is supplied to the electrodes from a source of current of definite frequency. This causes the rock to heat in the zone surrounding the contact while the interior remains cool; thus, differential expansion occurs and the rock breaks.

So far, the project, under the direction of MSU's Francis M. Young, has met with limited success. High-conductivity rocks are easier to break than low-conductivity rocks and small pebble-size rocks easier than larger ones. Water in the rock aids the process. Generally the rock tends to split rather than disintegrate.

Ultimate goal of the researchers is to provide a method of secondary breaking for use in areas where drilling and blasting is difficult, such as in underground chutes. Once portable equipment is developed, the method could conceivably crack hung-up boulders enough to break them loose without drilling.

Sherman Concentrator Begins Operations

OLIVER MINING CO., has put its new beneficiation plant at the Sherman Mine into operation. According to C. F. Beukema, president of the U.S. Steel's Oliver Iron Mining Division, "This is the third expansion in beneficiating facilities since this mine started operations thirteen years ago."

The Sherman Concentrator processes low-grade ores from both the Monroe and Sherman mines, and operates in conjunction with previously built crush-

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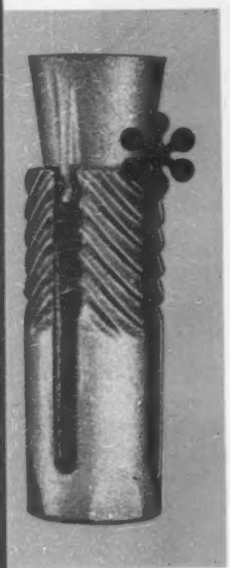

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The new, four-section mill contains a scrubber, crusher, screens and washing equipment, cyclones, spirals and a heavy-media plant.

New Aluminum Plants For the South . . .

CONSOLIDATED Aluminum Company of Jackson, a Swiss-owned company, notified Tennessee Valley Authority Aug. 19, that it will build a $27-million basic aluminum plant. The plant will be built near the New Johnsonville, steam-electric plant recently built by TVA, Bauxite for the plant will be shipped by barge from the Gulf Coast.

Howe Sound Co. has narrowed its choices of sites for a new $45-million aluminum plant to either New Johnsonville, Tenn., Calvert City, Ky., or Decatur, Ala.

. . . And Maybe Japan

REPRESENTATIVES of a group of Japanese firms have conducted negotiations recently with Kaiser Aluminum & Chemical Corp., Oakland, Calif., in regard to a joint aluminum plant venture in Japan. According to a Kaiser spokesman, conversations about the project have been held, but no agreement has been reached. The Japanese firms involved are Yawata Iron & Steel Co., Kinoshita & Co. Ltd., and Nisso Steel Mfg. Co. Ltd.

IN THE U.S.

ALASKA

Norman Schaefer, Wausau, Wis., has started an exploration program on the Russell Schaefer cinnabar property. The work was limited to diamond drilling in an effort to determine whether the limited exposure has greater lateral and vertical extent than that in the open-cut exposed by the late Russell Schaefer, with future plans dependent upon drilling results. A total of seven men were employed on this project, up to early September. An appreciable amount of native quicksilver in the ore makes this an especially interesting occurrence. The property is on Cinnabar Creek, tributary to Upper Holitna River.

At Nyac, dredging operations are limited to the No. 3 dredge about 5 miles below camp, and the No. 4 dredge on Bear Creek, approximately the same distance above Camp. No. 3 is operating on 24-hour basis and No. 4 on 10 hour/day. Total employment on this operation has been reduced to 28 this year.

The Red Devil Mine is now employing only 38 men. No surface exploration is being done there this season. The mine

Yieldable Arches "give" to stabilize roof

Where conditions underground are unstable, Bethlehem's Yieldable Arch is often the best answer for dependable roof support. Utilizing the old technique of letting the enemy beat himself, the Arch yields gradually instead of steadfastly resisting, so that the overburden can settle into a natural arch of its own.

As long as pressures are excessive, the Yieldable Arch will continue to "give." As soon as stability is reached, the Arch holds the line.

A Yieldable Arch Set consists of curved U-shaped sections nested together and overlapped enough to permit clamping with husky U-bolt clamps. The clamps control the tightness in the joint, and permit yielding when the forces exceed the load for which the joint was intended. Each Arch set is connected to adjoining sets by means of horizontal struts, which add lateral rigidity to the structure.

Besides increasing mine safety, the Yieldable Arch offers high salvageability, and usually pays for itself within its first year of service. A Bethlehem engineer would like to discuss the Yieldable Arch with you. You can reach him through the nearest Bethlehem office.

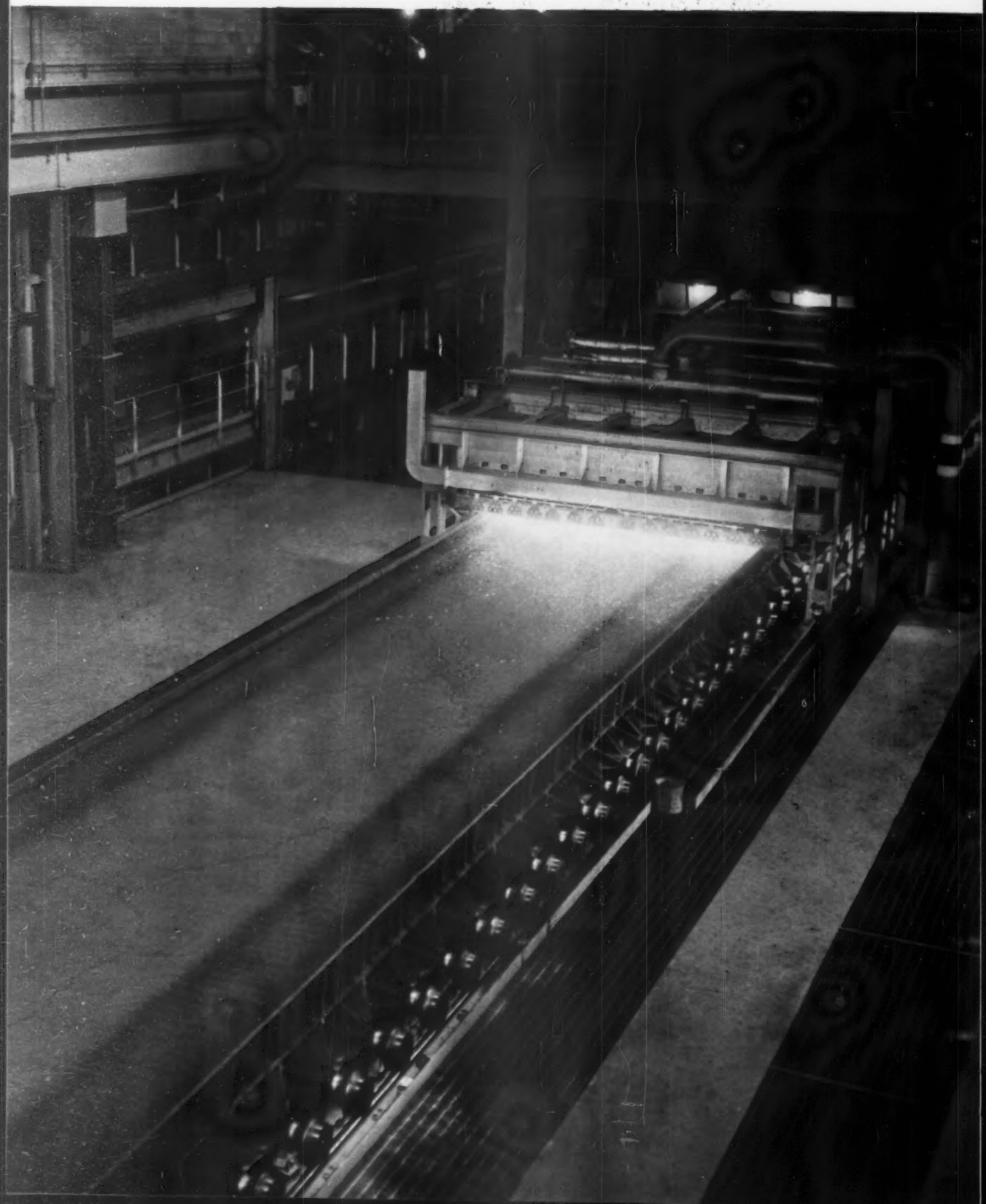
Steel *for Strength . . . Economy . . . Versatility*

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

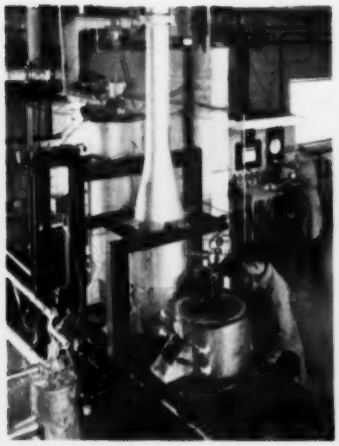
BETHLEHEM STEEL

BETHLEHEM STEEL

Agglomerates, Researches, Docks,



Concentrates, Handles, Builds

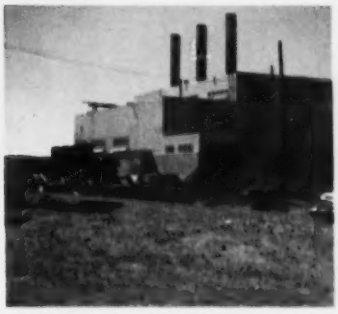


DOCKS: Large barge fleets dock at this steel company riverside facility to deliver raw materials or pick up outgoing shipments. Dravo pioneered cellular, sheet pile dock construction and has built them of all sizes for all types of industry. Dravo's 60 years' experience in heavy and marine construction can help you on projects such as docks, harbors, shafts, tunnels, foundations, water intakes. Check coupon below for information.

RESEARCHES: Dravo research explores agglomeration processes and establishes bases for plant design of complete pelletizing, sintering and briquetting facilities. Second Dravo-Lurgi ore pelletizing plant for a major metal producer is underway. Dravo-Lurgi iron ore sinter plants account for 45% of new U.S. capacity added in last 5 years. Mail coupon for facts.

CONCENTRATES: Interior of a Dravo-Lurgi magnetizing-roasting kiln, where low grade, non-magnetic ore is reduced to synthetic magnetite for separation by conventional equipment. Two pilot plants, one 10-ton per hour and one 2-ton per hour, are now in service in U.S. Use coupon for data on ore beneficiation processes.

HANDLES: 15-ton capacity ore bridge handles stocking and reclaiming needs of large steel producer's expanded yard. Dravo ore and coal unloaders and container cranes speed handling at mills, industrial plants, power stations, terminals and ports. For information on this equipment, check and mail the coupon.



BUILDS: One of five turn-key steam plants built for major auto maker. Other construction services include Dravo-Linde AG air and gas separation and Stora-Kaldo oxygen steelmaking plants; power and compressor stations; piping, machinery, pumping and water or waste treatment installations. Check coupon.

AGGLOMERATES: Total hearth area of 2,419 sq. ft. (13.17' x 183.75') makes this Dravo-Lurgi facility the world's largest single-strand sinter plant. Use coupon.

DRAVO

Dravo Corporation, 4780 Grand Avenue, Pittsburgh 25, Pa.

Please send me information on the following products and services

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- ☐ Pelletizing & Briquetting
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- ☐ Ore Beneficiation
- ☐ Oxygen Plants
- ☐ Mill Lubrication
- ☐ Turbo Blowers
- ☐ Space Heaters
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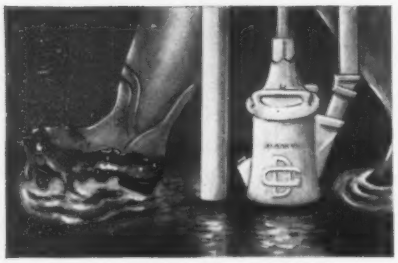
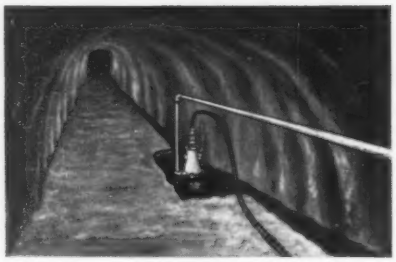
GARDNER-DENVER SUMP PUMPS SOLVE THESE DRAINAGE PROBLEMS



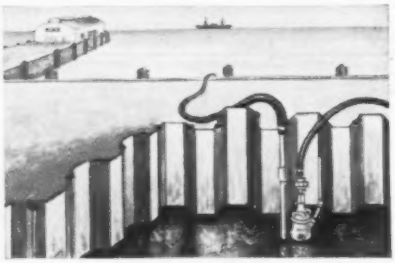
MUDDY BOTTOM—

Drain muddy sumps with the standard Model VP4. Capacities up to 230 gpm or heads up to 100 ft. Two connected in series—to make a Model VP4S two-stage sump pump—will handle capacities up to 224 gpm or heads up to 200 ft.



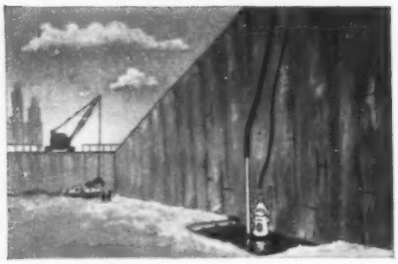
ACID WATER—

Use new stainless steel Model VP4N sump pump for corrosive liquid conditions. Performs with the same efficiency as Model VP4.



SALT WATER—

Model VP4B pump exterior constructed of bronze . . . resists salt water corrosion. Two connected make VP4BS tandem pump. Same high performance as Models VP4 and VP4S.



HIGH LIFT—

Model VP8 operates against heads up to 220 ft. . . . or pumps capacities up to 236 gpm. Direct flow through pump reduces fluid friction and turbulence.

In all Gardner-Denver pneumatic sump pumps, top suction reduces mud intake . . . keeps water and dirt away from oil seal while pulling lubricant into seal. Screen is located above pump casing to prevent clogging—even when pump rests on soft bottom.

Gardner-Denver sump pumps work away, worry-free. There's one to suit your application. Write for bulletins, or ask your Gardner-Denver man.

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BOSTRON

THE BELT WITH THE HAZARD-PROOF CARCASS!

WILL NOT ROT OR MILDEW — Constantly running salt water cannot rot or mildew 2-ply BOSTRON belt at J. H. Miles Co., Norfolk, Va. No deterioriation from fastener rust, no fastener holding problems.

OUTSTANDING WEAR — Constant impact and friction from razor-sharp oyster shells has not affected the 1/8" Dulon Cover on this BOSTRON belt. Says Mr. Frank M. Miles, President, "Our BOSTRON belt is good as new after 4 years operation . . . Exceeded every expectation!"

BOSTRON'S hazard-proof carcass, combined with Balanced Belt Construction, makes your investment in a superior Dulon Cover the most sensible, dollar-saving way to buy belts for your requirements.

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Please send free illustrated literature about the new hazard-proof BostRon Belts.

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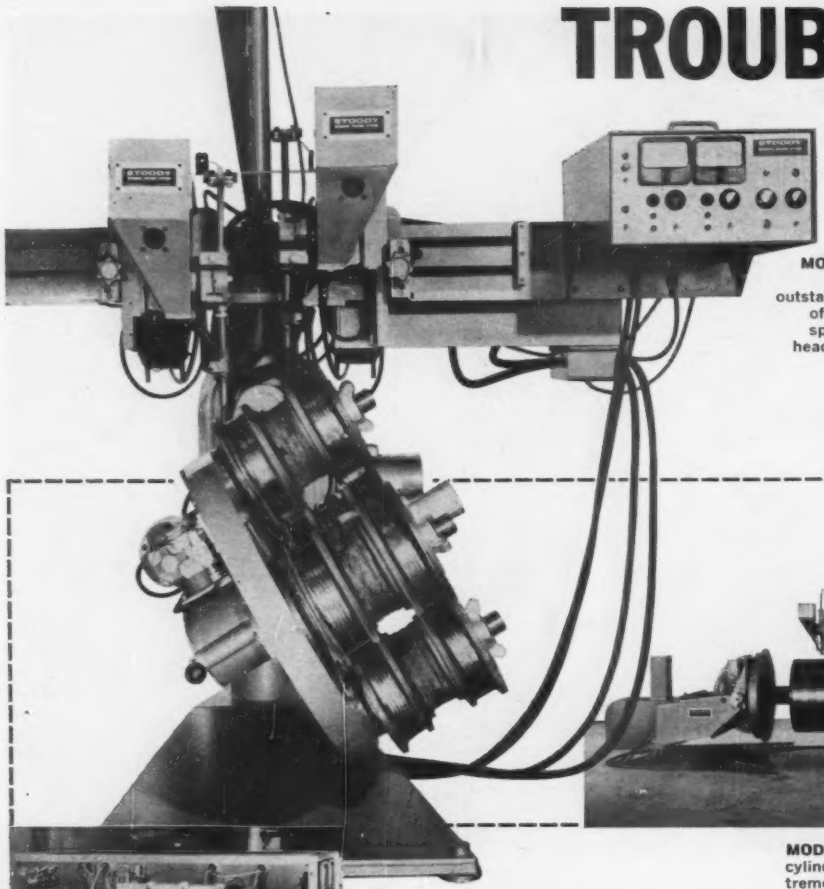
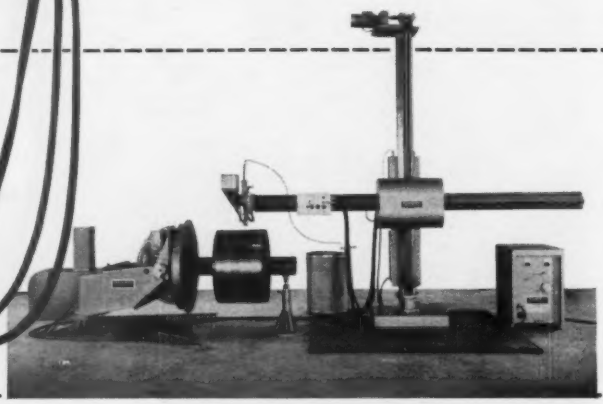
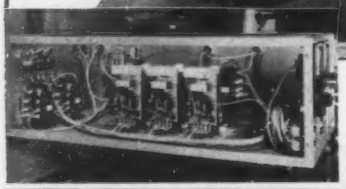
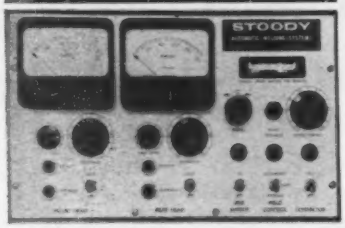


MODEL MR—a quality multi-spindle roller-idler rebuilding unit with outstanding operating features. Only Stoody offers a machine with offset main spindle support arm for minimum head adjustment from tread to flange.

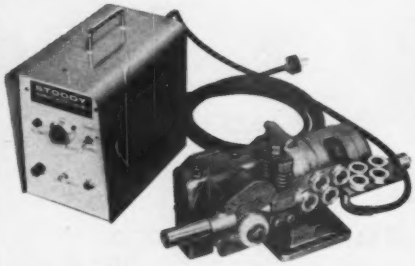


MODEL UW—a universal automatic system for cylindrical, conical or straight line welding. Extremely versatile machine for small or large parts.





ELECTRONIC CONTROL PANELS centralize all automatic functions in a convenient, efficient cabinet. All wiring is color coded and numbered. Components are interchangeable between systems.



THE COLD WIRE FEEDER shown above replaced the **weak link** in an existing automated overlay operation. This is one example of the advanced components that can be designed and made to modify an inefficient, troublesome operation into a smooth-working, high production system.

STOODY AUTOMATIC WELDING SYSTEMS consist of a series of automatic machines and advanced electronic controls designed for heavy-duty rebuilding and hard-surfacing functions. The machines incorporate latest design features, are abundantly powered to provide uniform feed rates regardless of wire size and load, and are equipped with variable feed rates for any required welding speed. They handle everything from tractor rolls, track links and idlers to heavy shafts, trunnions, large rolls, roll and gyratory crushers, etc.

STOODY AUTOMATIC WIRES—**A complete range of alloys** in continuous tubular wires, meeting all rebuilding and hard-surfacing requirements. Designed to give maximum wear life under specific operating conditions on virtually any equipment.

ECONOMICAL PAYOFFPAKS—Another advancement that increases production when used with Models MR, TL, UW and other STOODY machines. 500 lb. capacity reduces wire cost, permits uninterrupted welding on large parts, avoids storage problems and eliminates lifting of heavy coils on reels. 200 lb. HALFPAKS also available.

TYPE-S SUBMERGING MELT—A superior melt with easy removing characteristics—even at elevated temperatures. This valuable characteristic allows a much wider range of interpass temperatures on applications requiring preheat. Extremely uniform 8 x 48 mesh size.

STOODY COMPANY

11930 E. Slauson Avenue, Whittier, California

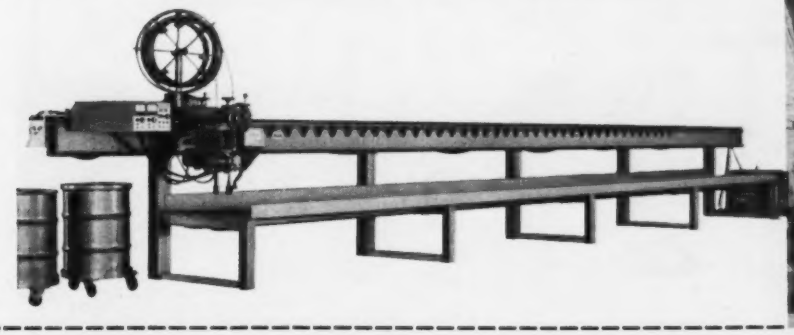
STOODY WELDING SYSTEMS

ALL Automatic Hard-Surfacing Overlay Applications!

Now Stoody, oldest name in hard-facing, offers an additional service to all automatic shops and rebuilders of heavy equipment... *a series of automatic welding machines designed for efficient, trouble-free performance!* Each machine performs specific functions on high volume operations. Construction is of highest quality—your assurance of long, uninterrupted service. For the first time, you can obtain both *machines* and *all hard-surfacing overlay requirements* from a single source, developed by a company whose name and reputation for quality has gained world-wide acceptance.

In addition, Stoody *will rework existing machines* to function with greater efficiency and minimum maintenance, and *will design specialized automation* for your specific needs, utilizing standard Stoody Automatic Welding System components.

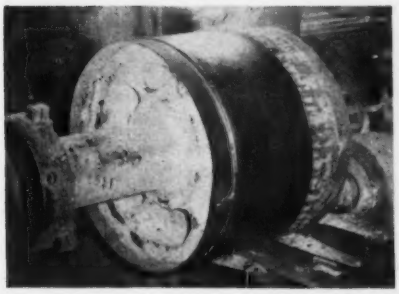
To get more for your hard-facing and rebuilding dollar call STOODY—40 years specialization in hard-surfacing. There's a STOODY FIELD ENGINEER in each dealer's area qualified to help you. To arrange a personal call simply phone your nearest dealer.



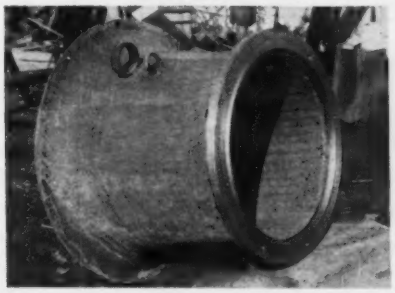
MODEL TL—the only dual-headed track link rebuilder that guarantees machine-tool quality construction for accurate, sounder weld deposits. Entire operation is electronically controlled from columnized cabinet.

THE CRUSHERMATIC is the result of equipment development to solve a specific overlay problem ... this unit completely automates the rebuilding and hard-facing of crusher rolls.

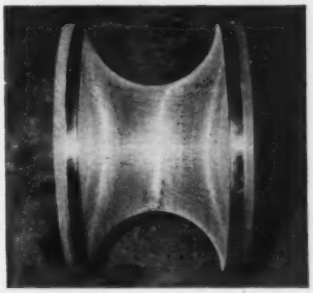
TYPICAL APPLICATIONS



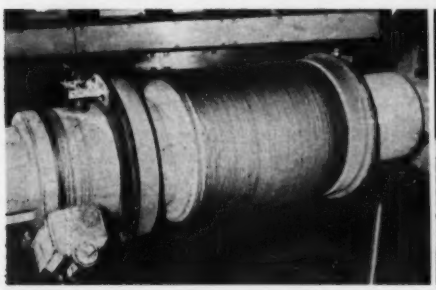
Trunnions are natural applications for Model UW which has a ram-type manipulator with a vertical travel from 6" to 8'-6" and a horizontal travel of 10'.

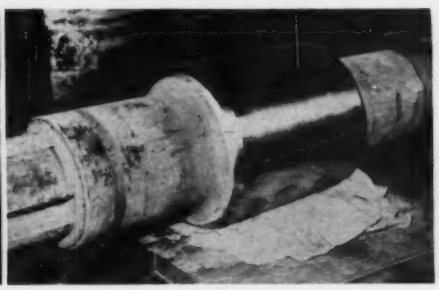


Inside diameters of many parts are hard surfaced regularly with automatic equipment. The catalyst lift pipe shown was overlaid with Stoody 100 HC.



Pipe forming roll overlay and size alteration with Stoody 102 has proved profitable to pipe fabricators.

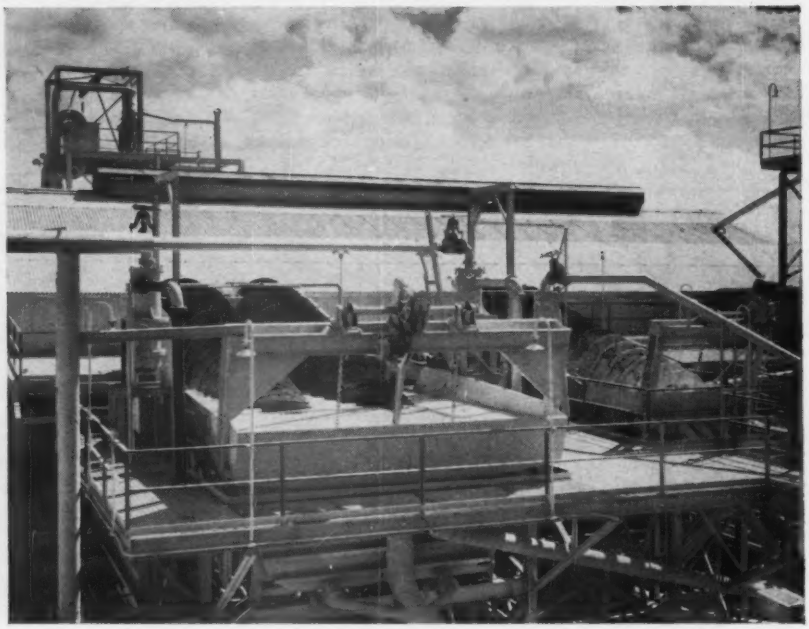




Flawless surface on banding strip finishing rolls—shown as welded and rough machined—was made automatically with high-hardness (60 Rockwell C) Stoody alloy.

AGELESS AKINS

1934 Akins Simplex Classifier still giving Dependable Performance for Virginia-Carolina Chemical Corp.



The 78" Akins Simplex Classifier, built in 1934, is dewatering coarse feed in a special flotation circuit. The new 72" Akins Duplex Classifier, with flared tank and serrated shoes, is dewatering and desliming flotation feed. Photo shows three of more than 200 Massco-Grigsby Pinch Valves purchased by Virginia-Carolina Chemical Corporation.

Working Beside New Akins Duplex

The 78" Akins Simplex Classifier, built in 1934 for a large mining company, was acquired by Virginia-Carolina Chemical Corporation in 1956. Based on its dependable and efficient operation the company purchased a 72" Akins Duplex Classifier and a 60" Akins Simplex Classifier for its Clear Springs phosphate plant in Florida. These classifiers were sold and serviced by Mine and Smelter's Sales Agent, R. H. Clark Equipment Co., Inc., Mulberry, Florida.

"Ageless" Akins Classifiers, for washing, desliming, dewatering, size separation, and closed-circuit grinding, are available in sizes from 12" to 84" spiral diameter, simplex and duplex, with standard or submerged spiral. Sand raking capacities up to 7860 tons per 24 hours; overflow capacities up to 2386 tons per 24 hours.

For complete information write for Catalog No. 601

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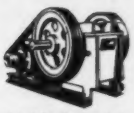
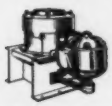
Laboratory Crushers and Pulverizers



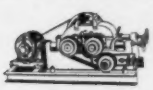
4"x 6" Massco Laboratory Jaw Crusher

Welded steel frame; manganese steel jaw and cheek plates; bronze bushed bearings; smooth jaws give better product and easier cleaning. Adjust for plate wear and product size by convenient hand wheel adjustment.



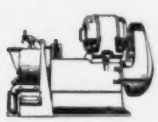
6" and 10" Massco Gy-Roll Reduction Crusher

Reduces ½" feed to as fine as 10 mesh in single pass. High capacity, low power consumption.



Laboratory Crushing Rolls

Sizes (Diameter x width): 10"x 6" and 12"x 8". Adjustable roll space setting up to ¾". V-belt drive. Heavy, cast frame absorbs vibration, results in long life.



Massco-McCool Pulverizers

Disc type grinder with a planetery movement. No gears. Will grind ¼" to 150 mesh in one pass.

Marcy Pulp Density Scale

Gives direct reading of weight; specific gravity of liquids, pulps, and dry solids; percent solids in pulp. Very accurate. Easy to clean.

MINE AND SMELTER SUPPLY CO.

The Company that cares enough to give you the best!

3800 RACE STREET
DENVER, COLORADO

OFFICES AND AGENTS IN PRINCIPAL CITIES

appears to be in a good ore position at present with six points available to feed the reduction plant. Drifting to intersect the Dolly ore zone on the 600 level is underway with around 100 ft remaining to reach the objective.

On the Parks mercury property, George Willis and John Murphy are operating a two-tube Joshua Hendy—McKay retort, with two 12 hour cycles per 24 hours. Each tube is charged with an average 150 lb of selected high-grade, with recovery of 55 to 60 lb of quicksilver from each 300 lb charge, or 110 to 120 lb per 24 hours. The retort tubes were obtained from the Ozzie Willis prospect, and date back to 1917.

Dorr Holloway and an associate are trenching with a small tractor on a cinnabar prospect located about ½ mile from the Kuskokwim River on the opposite side and a mile upstream from Sleetmute. Encouraging float has been found in subsurface "creeping" talus, but its source is not yet located.

CALIFORNIA

After two years of experimental operation, the $600,000 plant of Todd Industries, Inc., near Coalinga, has begun shipment of chrysotile slip-fiber asbestos to chemical firms and distributing companies. By mid-August three 40-ton carloads and five large truckloads had been shipped from the plant, mainly to Western Chemical Co., Los Angeles, and to a Salinas distributor which represents the Todd firm.

The Coalinga plant uses a new milling process, by which the asbestos fiber can be economically freed from the parent rock, which was designed by W. W. Davis of Davis Engineering Co., Phoenix, mill foreman at the Todd operation. Stanley Tanner of Hesperia, general manager, has been active in developing asbestos deposits for four years.

Todd Industries mines the asbestos by open-pit methods on property some 30 miles northwest of Coalinga. It is part of 10,000 acres sold by Mike-Ron Corp., to Todd, Hidden Splendor Mining Co., and Mineral Materials Co. The property adjoins holdings of Johns-Manville Corp. and Union Carbide Corp. in that area.

Future plans of the company include addition of a second circuit, for which equipment is now being installed, and facilities for direct loading of asbestos into trucks. Further expansion is planned as demand for the product increases.

Atlas Corp. in an announcement, said it has acquired some 2000 acres of asbestos territory in California, as well as a gold prospect in Wyoming and other lands in northern New Mexico.

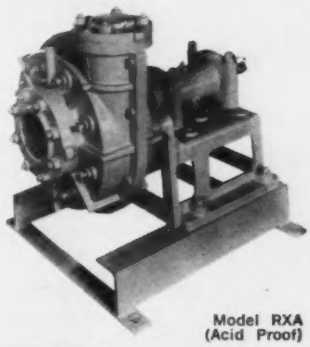
IDAHO

Lucky Friday Silver-Lead Mines Co. had net earnings of $1,081,994, in the first six months of 1961, which compares

Ceramic Lined or Rubber Lined Slurry Pumps

Lightning SLURRY PUMPS

Transfer Abrasive Fines Economically



Model RXA (Acid Proof)

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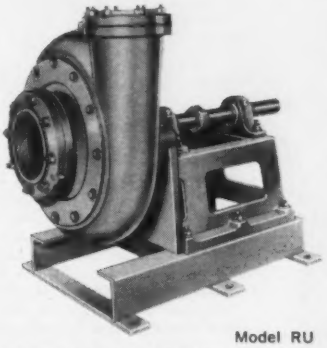

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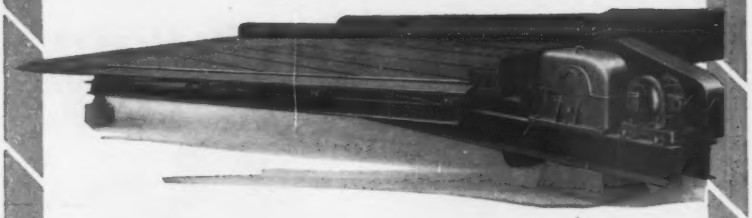

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with $592,614, for the same period of 1960, L. J. Randall, president, has reported to stockholders. Total operating income for the period was $2,985,130 this year compared with $1,887,417 in 1960.

President Randall announced start of operation of Lucky Friday's new hoist in September. It will permit Lucky Friday to mine below the 2600-ft level of the company's property at Mullan and eventually go to a depth of 5000 ft, Randall said. Present plans are for continuance of production at the rate of 650 to 700 tpd.

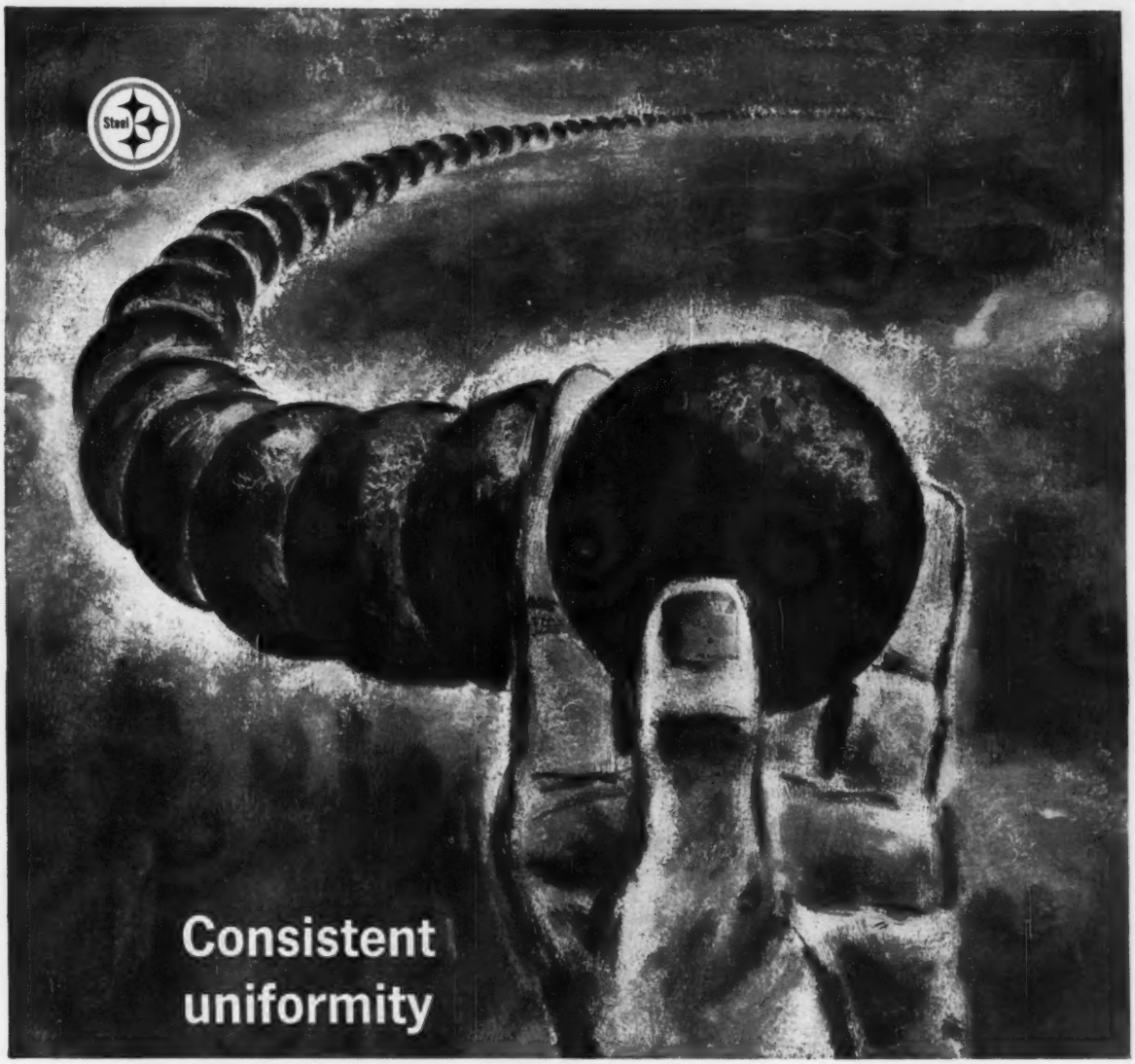
Silver Buckle Mining Co. of Wallace has announced plans for a geophysical survey, bulldozing and diamond drilling at its property in Lake gulch, west of Wallace. Dr. F. E. Scott, Wallace dentist, heads the company. He said the objective of the work will be the eastern extension of the new so-called North silver vein now being developed at depth in the nearby Galena mine of the American Smelting and Refining Co. This vein was cut by Asarco while exploring virgin ground north of the Polaris fault on the Galena 3000-ft level. Silver Buckle has also entered into an operating agreement with the Ottawa Silver Mining Co. of British Columbia, Canada, whereby Silver Buckle will take over the Ottawa's property near Slocan City, B.C., for operation on a 60-40 basis. Thomas C. Hughes, Spokane, Wash., is president of Ottawa Silver Mining Co.

U.S. Bureau of Mines research for lead and zinc during 1962 will include work in the Coeur d'Alenes of Idaho, where Bureau engineers will conduct laboratory and field tests on rock pressures and ground-support problems associated with deep mining. This will include tests on the effectiveness of pre-cast, segmented, reinforced concrete drift sets, explosive shaping of rock bolts to obtain rapid rock-bolt anchorage and the factors affecting the ground support of hydraulic stope fill.

About 1200 ft of crosscutting and drifting must be done on the new 2000-ft level of the Conjecture silver property near Pend Oreille lake in Idaho to reach the anticipated downward extension of the ore zone, Federal Resources Corp. of Salt Lake City, Utah, which is developing the property for Conjecture Mines, Inc., of Spokane, reports. Deepening of the three-compartment Conjecture shaft from the 1000-ft horizon to the 2000-ft depth was completed during the summer and designing of a mill for the property is in the preliminary stages, the report says.

W. C. Kennedy and Herb Zanetti, lessees of the Mountain Goat mine north of Wallace, are installing a $50,000 sink-float plant at their Rex mill near the property to upgrade "gob" left in old stopes of the adjoining Interstate-Callahan mine. The plant will be ready this fall and will operate at half of its 600-ton daily capacity.

Wonder Mining Co., Culdesac, Idaho,



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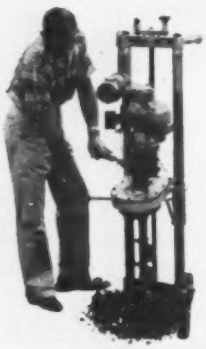

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has started driving a drift on the 225-ft level of its gold property four miles south of Golden, officials reported. They said the ore vein is averaging 3 ft in width and is running from one to 4-oz per ton. The property is located along the South Fork of the Clearwater river in one of the state's earliest gold mining areas.

MICHIGAN

Pickands Mather & Co.'s plan to reopen three of its recently closed Gogebic range underground mines was rejected by the United Steelworkers as being "unrealistic." The company had proposed a new incentive plan, based on existing hourly rates, which would include all employes. It would:
(1) suspend all existing incentive plans for three months;
(2) continue the present pension and insurance agreements without change for an extended period (the union demands some changes) and,
(3) substitute a reasonable time for lunch on the job in place of a fixed lunch period.

The company said it had hoped its proposals would be acceptable to the union since they would not lower present wage rates or affect increases provided for in the present contract. Pension benefits, insurance coverage and other fringe benefits would also be preserved as presently provided. All items were completely rejected by the union.

The mines which might have been reopened were the Peterson and Geneva near Bessemer and the Cary at Hurley.

The stockpile at Pickands Mather Sunday Lake underground mine at Wakefield, closed in February, has been shipped and the underground equipment is being dismantled and brought to surface. The Sunday Lake was the most easterly active mine on the Gogebic range, and was a prominent producer for about 60 years.

Hanna Coal and Ore Co.'s Cannon underground mine near Stambaugh, on the Menominee range, has completed work on converting its hoisting system from manual to automatic control. The work was begun last year. Under the new arrangement the cage hoist can be operated by push-button from all levels. The cage travels at 1500 fpm. The ore hoist travels at 1800 fpm and is semi-automatic. The skip-tender starts the ore hoist from the bottom of the shaft. The new system has introduced many new safety and efficiency features into the Cannon mine operations.

MINNESOTA

The Lake Superior Mines Safety Council held its September meeting at Ely on the seventh. The morning program included a talk on welding by Russell Dahlner of the Smith Welding Co. L. E. Anderson of Union Wire Rope Co.

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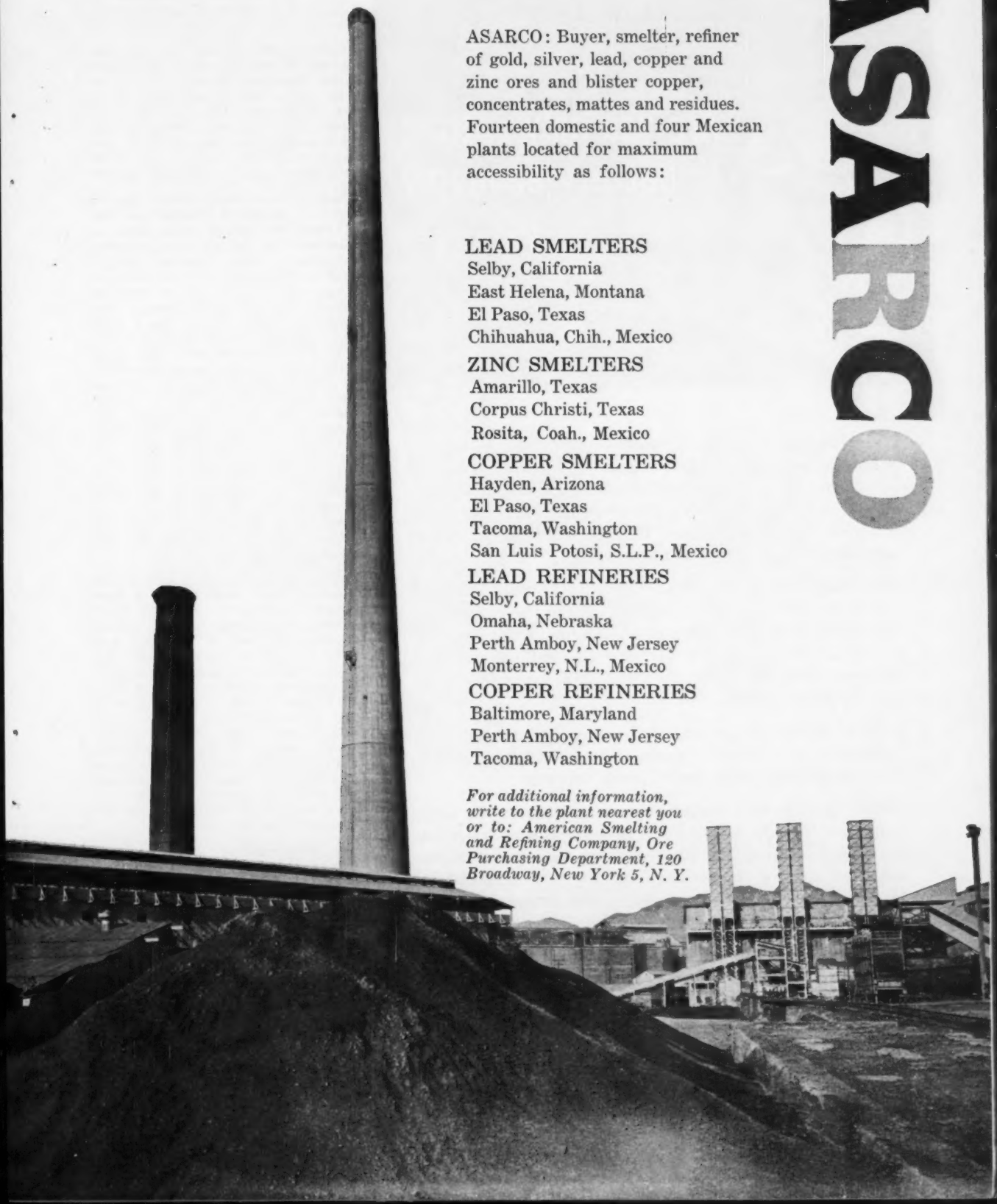

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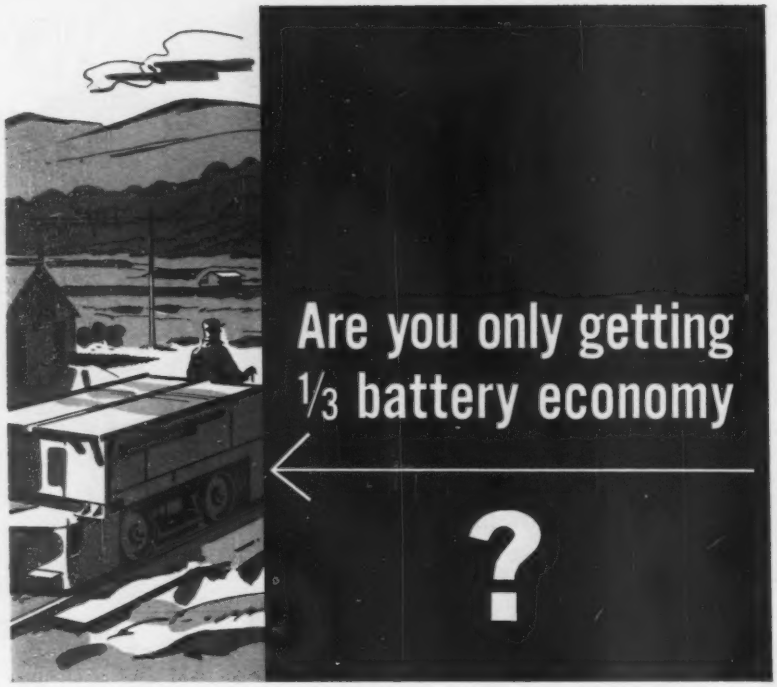

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The Electric Storage Battery Company

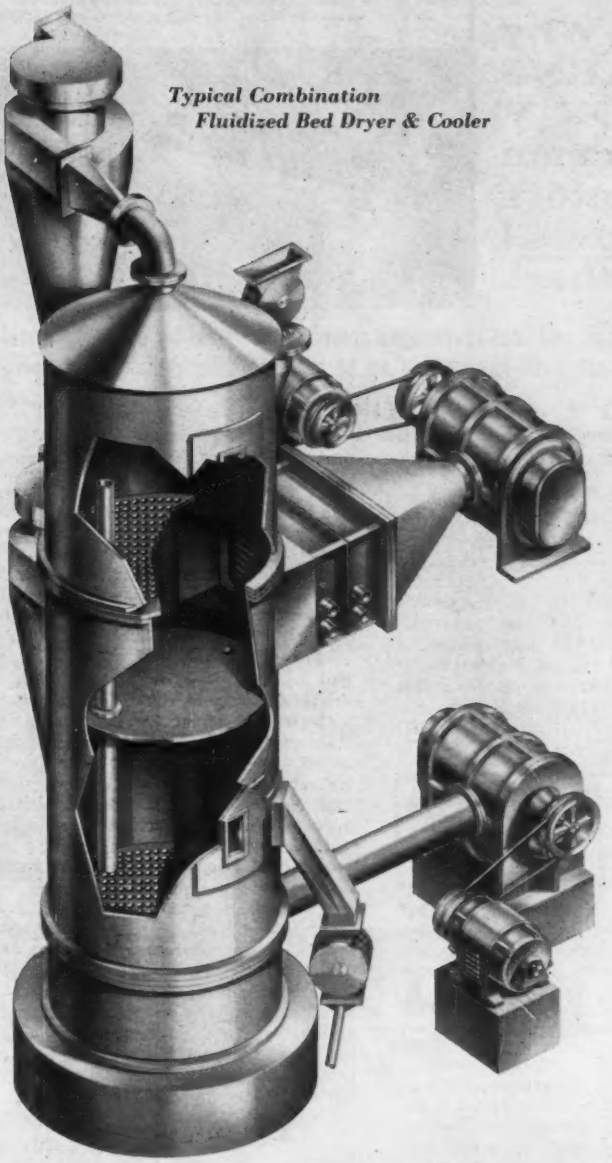
talked on the care of wire rope; and Thomas W. Richard, supervisor of training for Reserve Mining Co., discussed communications in safety. The afternoon session was taken up by a talk on the increased use of hard hats by Louis J. Zaverl, U.S. Bureau of Mines and one on the care and use of grinding wheels by Wm. Hemsley, of the Simmons Co.

Northern Natural Gas Co. has completed the 61-mile natural gas pipeline from Duluth to Silver Bay. The 16 in. line has a 3-mile branch into the city of Two Harbors, and a one-mile extension into Silver Bay. Testing the line was completed in time to permit service to the Reserve taconite plant and the two communities to begin in September.

Zontelli Bros., Crosby-Ironton, plan to send ore samples of about 60 tons from Cuyuna and Mesabi range mines to Germany this fall for direct reduction experiments. John Simmons, manager and metallurgical engineer for the company, said the tests will be conducted by the Friedrich Krupp Iron & Steel Works in Essen where it has a direct reduction method pilot plant. The tests will be conducted under a $77,500. grant authorized by the Iron Range Resources & Rehabilitation Commission. For the tests, about two to four tons of ore will be used per day in 14-day cycles. The entire program will require from 30 to 60 days. It will also use about 30 tons of American coal and 16 tons of American limestone. Dr. George St. Pierre, professor of metallurgy at Ohio State University, and former director of Inland Steel Company's direct reduction research program, is working with Mr. Simmons on the project.

Reserve Mining Co., Silver Bay, recently purchased four small islands in Lake Superior, offshore from the E. W. Davis taconite plant, which had title records requiring that they be purchased with Civil War soldiers' scrip. A Civil War soldier had received a preemptive claim to the islands which were part of lands made available to Civil War veterans and which they could purchase with soldiers' scrip. After a long, nationwide search, Reserve Mining Co. attorneys found, in Helena, Mont., enough of the necessary scrip. Collins Land Co. acquired the islands for Reserve and they now are a part of the Silver Bay taconite company's land holdings.

The Minnesota State Land Exchange Commission has approved an application of the Lake Superior Realty Co., Duluth, to appraise private lands for possible exchange of state lands south of Eveleth. The Realty Co. says it represents Oglebay Norton Co. of Cleveland and proposes to exchange 3308 acres of privately owned land in St. Louis, Cook and Lake counties, within state forests, for 2666 acres in St. Louis county south of Eveleth. Edward W. Sloan, Jr., president of Oglebay Norton, told Gov. Anderson's office by telephone that the passage of the taconite amendment to Minnesota's state constitution would be "very helpful" and a "very important factor" in the decision of industry to build other tacon-



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Stearns INDOX V permanent magnet wet drum separators (Type WPD) have established new cost reduction and performance standards for the mining industry in both heavy media and ore concentration applications.

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For example, here's what one user recently reported: *"Comparing the performance of a Stearns WPD against a larger electro unit in our two parallel iron ore heavy media systems proved the superiority of the* INDOX *separator to us."* Here are the exact results of that test with the figures indicating loss of magnetic media in grams per gallon of feed under varying feed rates but with conditions in the two circuits always identical:

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However, performance is just part of the story. Stearns INDOX V separators offer other significant advantages, such as:

Lower Initial Cost — Amazing INDOX V permits cost reductions never before possible.

Lighter Weight — Electros are twice as heavy, and ALNICO permanent types are up to 60% heavier than Stearns INDOX V WPD separators, which further adds to initial cost of competitive units.

Less Costly to Operate — Electros require current for coil energization, which in the average installation can run up to $500 annually.

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ite plants in Minnesota. The Oglebay Norton Co. activities in taconite exploration work in the Virginia-Eveleth area were reported in the company's 1960 annual report. While there is no assurance that a taconite plant will be built, this is seen as a possible first step.

Inland Steel Co.'s Armour No. 2 underground mine at Crosby is shipping from underground and stockpile. It employs 117 men who are working five days per week on two shifts.

The Robert open pit mine of the M. A. Hanna Co.—operated as the Kennedy underground mine by Rogers Brown Ore Co. from 1911 to 1923—at Cuyuna Village, sends part of its production to the Portsmouth open pit mine washing plant. The rest of its output is direct shipping ore.

The Mahnomen open pit, Cuyuna Range, which M. A. Hanna Co. recently acquired from Pickands Mather & Co., is working and expected to make a good shipment in 1961. It was operated by PM&Co from 1928 to 1960. The Mahnomen has a screening and crushing plant in the pit from which the ore is carried to surface by belt conveyor. The ore which requires treatment is trucked to the heavy media-cyclone plant at Hanna Co.'s Maroco open pit mine. The Maroco made no shipment in 1960.

Receipts of Lake Superior area iron ore at U.S. Steel plants totaled 20,601,000 tons for the first seven months of 1961, down 45% from 1960. The 1961 Lake Superior area total was less than one half the 41,823,000 tons U.S. total receipts for 1961's first seven months, which in turn was down 40% from a year ago.

MONTANA

Geologists of the Northern Pacific Railway Co. are making a geologic reconnaissance of the railway's large holdings in the Thompson River drainage as part of a study in the Silver Butte mining district, where the NP has substantial mineral ownership.

Work in this area was started in July and will be completed by mid-September. Hugh T. Mitten. assistant NP geologist, is in charge of the work under the general direction of Ernest E. Thurlow, chief mining geologist.

The entire northwest Montana area being studied by the railway involves about 2500 square miles lying between Flathead Lake and the Idaho line. "Northern Pacific owns approximately 12½% of the acreage and there are several known mineral deposits in the area," according to Thurlow.

A. J. Katches, director of Great Western Chemical Mining Corp., said that Senators Mike Mansfield and Lee Metcalf of Montana have joined Wyoming senators in urging consideration of stockpiling strategic materials at Sundance, Wyoming. Congressman James Battin was also reported as supporting the development of reserves in this area.

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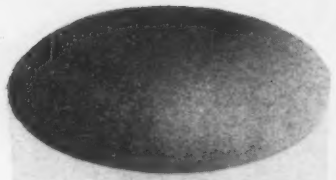

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Katches also said his company wants to develop Bear Lodge Mountain area nine miles north of Sundance. The area's reserves of thorium and rare earths are "perhaps the largest hard-rock deposits ever discovered," he claimed.

Announcement of suspension of the work of reactivating the Leonard Mine, Butte, was made in August.

E. I. Renouard, vice president, said high costs and the need to place more men on production were responsible for the decision to halt the project.

The Leonard Mine, located on the east side of Butte Hill, has not been in production but development and reactivation work have been under way in the mine.

The company said contract miners at the Leonard were being transferred to production jobs in the Mountain Con, Steward and Kelley mines.

It was noted that there recently has been a shortage of contract miners in Butte and that transfer of men from the Leonard to producing properties will avert a decline in production.

The Leonard has been employing about 100 miners. In addition, about 35 men employed in the Kelley, have been at work in production on Leonard ore reserves. There will be no change in this project.

Work started last March to reopen the Leonard which had been shut down since June, 1958. Production of some ore from the Leonard was expected to start by the end of this year.

Renouard said there is no change in the plan eventually to make the Leonard an operating unit in the deep-level mining program here. Work on other phases of deep-mining project is continuing now.

The Bunker Hill company of Kellogg, Idaho, has taken over the operation of the Nancy Lee mine near Superior, under a lease agreement and has put a dozen men to work there under the direction of Charles Hathhorn, who was formerly superintendent of the Bradley Mining company's Ima tungsten mine in South Central Idaho and for the past several years assistant mine superintendent of Bunker Hill.

Spokane National Mines, Inc. placed its 150 ton cyanide-flotation mill at Baimack into operation last month. The crushing section of the mill has been redesigned to include a scalping screen and Allis Chalmers Cone Crusher.

At present silver-lead ore from the Polaris Mine owned by John and William Hand is being milled on a contract basis. Approximately 11,000 tons from the mine is being trucked to the mill.

Spokane National has started drifting both to the West and East on the 60 ft level of its new Quien Sabe shaft. The workings are in new virgin ground located between the Old Stapleton Tunnel and the Midway Tunnel which produced high grade ore averaging 149.6 oz in silver from 1871 to 1905.

High grade ore of 100 oz silver or more, is being sacked for direct smelter shipment. Development ore in the shaft has averaged better than 30 oz which the company will mill during the winter after the completion of the Polaris contract.

Robert Burns, company geologist, has completed mapping the surface and underground workings of the New Departure Mine. This makes possible for the first time the intelligent development and mining of high grade ore veins that have been worked since 1871.

NEVADA

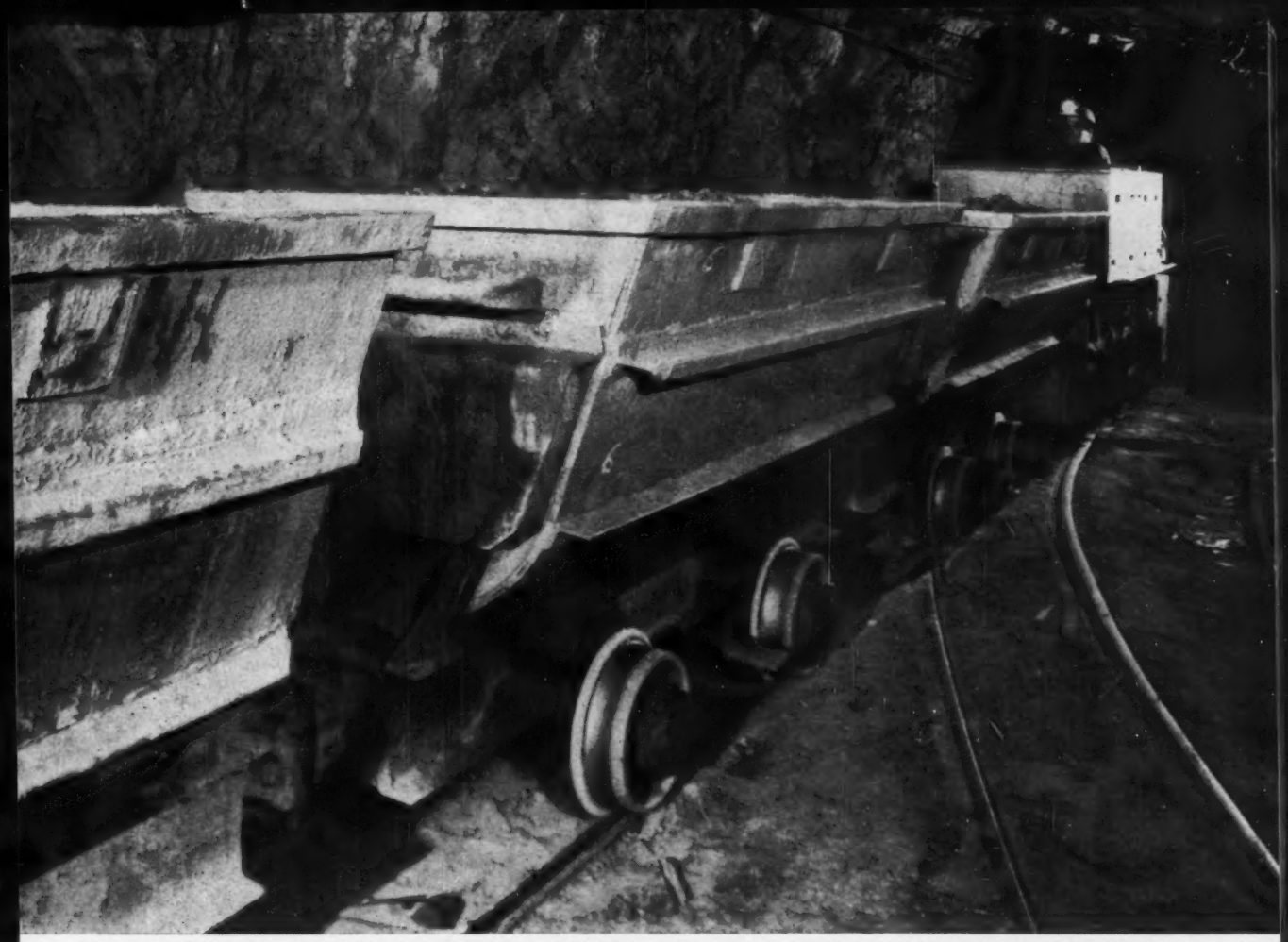
U. S. Milling & Minerals Corp. closed its mill in Silver Peak, Esmeralda County, during August. Rising costs and low prices for gold and silver were reasons given for the action by R. O. Camozzi, general manager. The shutdown left 23 mill workers without employment. Also closed were five mines, employing a total of 74 men, which USM&M leased to supply the mill. These were the Gold Hawk at Silver Peak, the Ohio and Western at Gold Point. the Tonopah King at Tonopah, and a newly opened mine at Weepah. Other mines in the area which depended on the Silver Peak installation to mill their ore will be affected by the closing. USM&M bought the Bruhi mill at Silver Peak from Avery Brundage and remodeled it to treat Mohawk ores. They completed paying for the mill more than a year ago, and the company was one of Nevada's larger employers of mine and mill workers. Sam Levine, president of the company, was in charge of the mining and milling during most of the years of operation.

White Caps Gold Mining Co. which operates the White Caps mine at Manhattan, has also leased the Watt and Patriot. Work of reactivating the former silver producers is being directed by Hugh Cameron, White Caps superintendent, who said he plans to get both properties into production without delay. Electric generators and electric hoists have been installed, and the Watt has already been cleared to a depth of 350 ft. The Patriot has been pumped out, surface water having filled it to the 250-ft level.

Brownstone Mining Co.. of Lone Pine, Calif., has been awarded the contract to develop White Caps Gold Mining Company's beryllium property in Owens Valley. Hugh Cameron, White Caps superintendent, said examination of the present tunnel shows the mineralization is tied to an epidote dike which passes approximately 20 ft north of the present workings. It is almost parallel to the tunnel, which is 100 ft in length. Samples from the dike show a free intermingling with beryllium crystals, Cameron said. The epidote is visible and runs for several thousand feet. In some places it is 50 ft wide.

Dean Kirk has two men working with him at his Blue Point turquoise mine 45 miles from Battle Mountain in Lander County. Work is by open pit.

The American Potash Chemical Corp. plant at Henderson was damaged by fire



Ten years' life is expected from the 5/16" liners of USS "T-1" Steel. No failures have occurred in over four years of 24-hour daily service handling abrasive ore.

USS "T-1" Steel takes a 58,000-ton beating!

Thirty times a day, *for four years*, highly abrasive copper ore has grated through these cars. Each car has hauled about 58,000 tons of ore and *not one of the liner plates of USS "T-1" Steel has worn out!* In fact, the mine operators expect a minimum of 10 years' service.

Twenty of these "C. S. Card," U-bottom, dump-type mine cars with side and bottom liner plates of USS "T-1" Steel are working at a copper mine in Arizona. The USS "T-1" Steel is heat-treated to a hardness of 321 Brinell which gives it tremendous resistance to impact abrasion. The body plates of the cars are USS COR-TEN High-Strength Low-Alloy Steel which offers high strength at a 50,000 psi minimum yield point, and 4 to 6 times the atmospheric corrosion resistance of carbon steel.

The purchasing agent says, "We used to encounter considerable wear along the bottom of the door of the old A-frame-type cars. This caused the ore to leak out and pile up on the track. In turn the highly abrasive effects of pyrite, which comprises 50% of the ore, wore down the wheel flanges, causing them to fail. Any such wheel failure meant several hours lost production time until service was restored and the ore transferred. *We have not had any downtime on the 'T-1' Steel cars except for normal replacement of wheels.*"

"T-1" Steel's performance has been so outstanding that its use is being considered for replacement liners in ore-car loading baskets, skip car liners and the side walls of slusher drifts.

USS "T-1" and the new, lower cost "T-1" type A Steels have a minimum yield strength of 100,000 psi or a minimum hardness of 321 Brinell, depending on the application. USS "T-1" Steel can also be furnished to 360 minimum Brinell. All are tough, weldable steels with superior resistance to impact abrasion. Find out how they can lower your operating costs or reduce weight with no loss of strength. For more information, or to borrow our new 18-minute, 16mm color motion picture, "How to Weld USS 'T-1' Steels," for welder training purposes, write Room 6330, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS, COR-TEN and "T-1" are registered trademarks.

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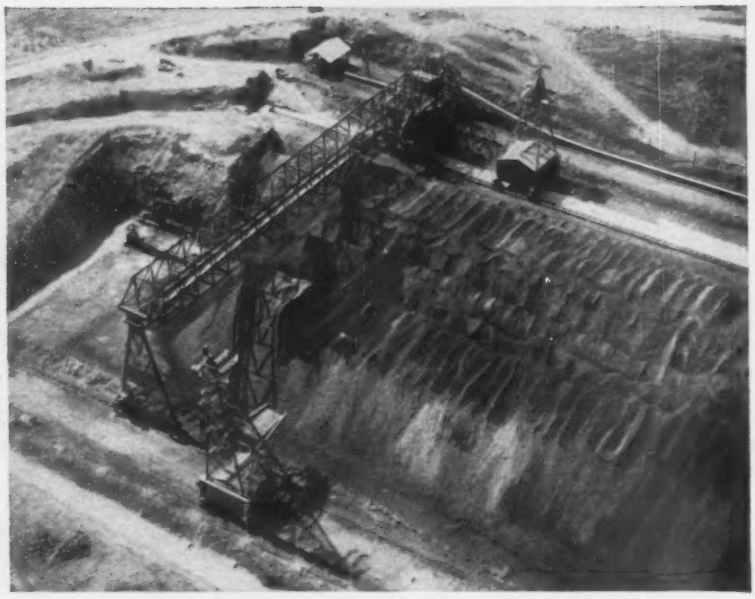
USS United States Steel

They Blend and Reclaim From A Million Ton Stockpile

with a 10-Yard Cableway DragScraper



At this 400-ft. by 1,000-ft. storage area, ore is reclaimed from an 80-ft. stockpile to two 3,000-ltph. longitudinal conveyor slots. Ore directly over the slots is reclaimed by gravity—all remaining material is handled by a 10-yd. Cableway DragScraper.

Before the Sauerman Machine was installed, ore was moved to the slots by a small fleet of crawler units operating on the ore pile. Steep slopes and great heights made their operation hazardous.

To eliminate this and reduce labor costs, the crawlers were replaced by the Sauerman Cableway DragScraper. Now, no men are needed on the storage pile, and ore may be reclaimed from any point in the area at will. The latter feature is particularly helpful in blending the ore and insures uniform quality.

The Cableway DragScraper consists of two self-propelled towers paralleling the storage. A 10-yd. DragScraper Bucket and carriage ride the track cable suspended between them. Electrically driven drum hoists located in the towers control hauling, hoisting and conveying. Despite its size, the Sauerman unit can be operated by one man.

DragScraper Machines are built in sizes from ⅓ to 15 yds. to handle stockpiled bulk material in both outdoor and indoor storage facilities. Write or call about your requirements. We'll recommend the proper machine for you and forward appropriate literature.

SAUERMAN BROS., INC. 626 SO. 28th AVE. BELLWOOD, ILL.
Linden 4-4892 • Cable CABEX—Bellwood, Illinois

Crescent DragScrapers • Slackline and Tautline Cableways • Durolite Blocks

and an explosion during August. The blast occurred when workmen repairing a plugged line released some boron hydroxide which mixed with air and exploded. Nobody was badly injured but company spokesman said some time will be required to put the plant back into operation.

A. E. Clark, of Los Angeles, and Harry Williams, of Inglewood, Calif., are conducting placer operations in Goehring Gulch, Esmeralda County. They are using a new dry washer for extraction of gold values.

Leprechaun Mining Co. has a drag line and other equipment in operation at their properties on Clayton dry lake near Silver Peak. C. P. Keagel and Bob Zuber are in charge of a crew which is doing exploratory work in the area.

Leo Osborne, Jim Freeman and Jim Goldsworth, of Yerington, are reopening the Wilson gold property in Lyon County and have already completed construction of a road to the site. The mill lies in the Pine Grove district and prior to 1900 produced $3-million in gold values. The new leasers have moved equipment onto the site and expect to produce ore early this fall.

Desert Minerals Corp. which owns iron ore claims adjacent to U.S. Steel holdings in Lyon County, has announced plans for development of the property. The statement was made by Carl Roan, president, at the first stockholders' meeting held at Yerington during August.

Kennecott will spend some $300,000 this year in an exploration program in the Robinson district in eastern Nevada as part of a $2.5-million ore probe.

Drilling is under way in the Ruth pit and the program will generally be confined to pits around Ruth to investigate the possibility of ore mineralization between depths of about 1200 ft and 3000 ft. These zones have never been probed before.

Kennecott officials point out that this is in addition to regular development drilling in the area and represents a long-range study of ore sources.

NEW YORK

International Nickel Co. will build a new metallurgical research center at Sterling Forest, on a 150-acre site purchased last month. R&D facilities at Bayonne, N.J. will be transferred by Inco within two years, when the new center is expected to be completed.

Nickel-alloy research and work on platinum metals will be emphasized at the new laboratory, which will be near the Union Carbide labs and nuclear reactor, also at Sterling Forest.

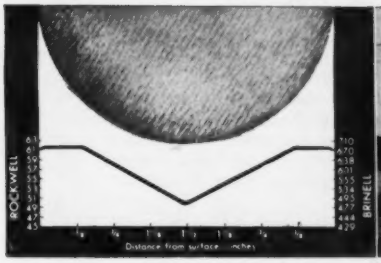
OHIO

The first shipment of rock salt from International Salt Co.'s new Cleveland Mine at Whiskey Island, on Lake Erie,

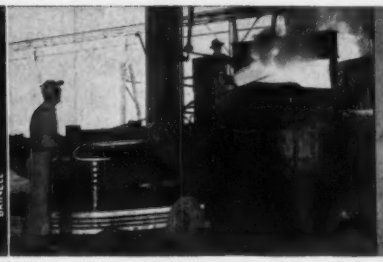
Naco Heat-Treated Cast Alloy Steel Grinding Balls

Through precise laboratory controls of the elements in steelmaking — right from spectrographic analysis through final heat treating — Naco Grinding Balls possess the precise structure and hardness for maximum impact absorption and wearing qualities. That's why Naco Grinding Balls are solid favorites with hard-to-please mill operators doing tough grinding jobs.

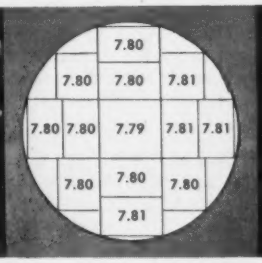
A-5227A



HARD. Curve shows controlled hardness between surface and inner core. Figures are average hardness of samples taken from representative production runs.



TOUGH. Naco Balls resist breakage longer because of close metallurgical control in electric furnaces . . . quality controlled pouring into special molds . . . careful heat treatment.



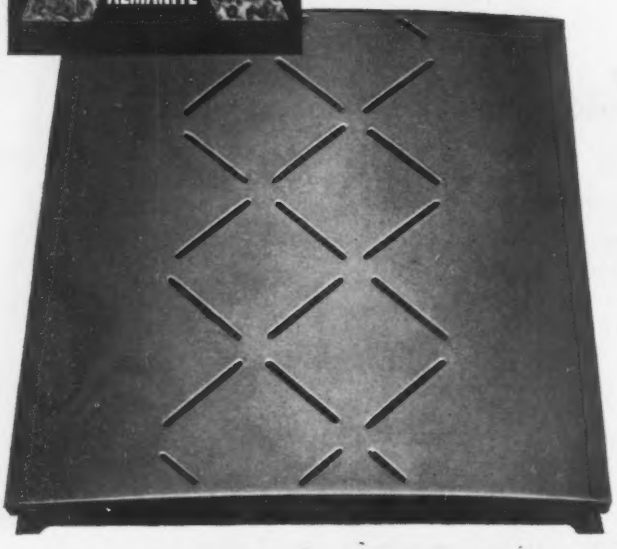
UNIFORM SOLIDITY. Grid, at left of X-ray photograph of Naco Ball, shows average specific gravity of various sections. Figures are from 169 three-quarter inch sections from 13 production balls.

NATIONAL CASTINGS COMPANY
Cleveland 6, Ohio

CAPITOL FOUNDRY DIVISION
POST OFFICE BOX 750
PHOENIX, ARIZONA

NACO CAST STEEL HEAT TREATED GRINDING BALLS • SHOVEL TEETH • MILL LINERS • DISCHARGE GRATES • CRUSHER JAWS • MANGANESE STEEL CASTINGS • CARBON AND ALLOY STEEL CASTINGS

NEW ABRASION RESISTANT METALS



ALMANITE®

Offers Wide Combination of Hardness and Toughness

Combining the better properties of martensitic white irons with those of austenitic manganese steel, ALMANITE is the most versatile wear resistant metal ever produced. The wide range of structures and properties available in this new group of Meehanite metals makes it possible to specify a material that provides the best combination of hardness and toughness required for different wear conditions.

There are three basic types of ALMANITE-type W for general purpose abrasion resistance; type WS for high impact and abrasion; and type WSH for severe pounding impact with abrasion. These blend into each other and modifications of all types may be specified.

ALMANITE WSH, an austenitic nodular iron possessing high strength, toughness and ability to work harden in service, was used for the 1100 pound jaw crusher casting shown above. Used to crush 8-inch rocks to 1½-inch size in one pass, test castings have worked 57 days, crushing 100 tons per hour for 8-10 hours per day without substantial wear and with no metal flow. Average life for austenitic manganese steel jaws is about 35 days.

For more information about ALMANITE, send for your free copy of the 12-page brochure illustrated. Write to: Meehanite Metal Corp., New Rochelle, N.Y.

MEEHANITE METAL

MEEHANITE CASTINGS ARE MADE ONLY BY MEEHANITE FOUNDRIES.

was made late this past August.

The 20-ton shipment, from development operations, went to Republic Steel's power house in Cleveland to be used in water softener regeneration.

International Salt's mine will be designed for 1.5-million tpy capacity, and is to be dedicated in the late spring or summer of 1962.

Two vertical shafts, 16 ft wide and more than 1700 ft deep have been sunk into the deposit and drifting begun.

TENNESSEE

Automatic hoisting equipment is being installed at Tennessee Coal and Iron's Jefferson City zinc mine. Previously all ore hoisted from this large underground mine was done with manually controlled hoists. Two other zinc mines in the district already have automatic hoisting installations. The mines are New Jersey Zinc Co.'s Flat Gap mine, near Treadway, and the Jefferson City mine at Jefferson City.

Engineering on Tri-State Zinc Co.'s 2100 ft shaft at the New Market zinc mine is scheduled for completion Oct. 1. The contract will then be let for sinking the circular shaft. The shaft will be designed to permit the use of an emergency diesel-powered hoist instead of the conventional ladder way. Mining people in the East Tennessee zinc district estimate that it will take three to four years to complete the shaft.

A major metals group headed by Ross Bohannon, an attorney from Dallas, Texas, is exploring the Tennessee Valley area for a site for a $42-million steel mill.

Enough progress has been made by American Zinc Co. on the use of ammonium nitrate-diesel fuel explosives to permit them to switch entirely to this method of blasting at their Young mine. Rock at this large underground zinc mine, located near New Market, is tough Ordovician dolomite. The explosive mixture is emplaced in the horizontal drill holes under a pressure of 15 psi.

UTAH

Kennecott Copper Corp.'s Utah Copper Division has let contract for removal of 12-million tons of overburden to Western Contracting Co. at Bingham Mine.

This is the third "contracting-out" action by the big copper firm in recent years.

Western is now completing job of equal size. And the firm previously copped a 10-million cubic yard removal contract in the first contracting deal.

Western, in latest contract will strip 6-million cubic tons respectively over next 12 to 14 months from east and west sides of the Bingham Pit.

The contractor will use 32-yd trucks and 13 cubic yard dippers.

An 80-cubic yard truck also is in operation at the pit in the overburden job.

Operation Duclone...

There appears to be agreement among astronautical scientists that the moon's surface is knee-deep in dust. If we let our imagination run wild a little, we can visualize a space armada of Ducon Cyclones zooming to the moon to clean it up for the benefit of tomorrow's tourist trade.

But, before we get too wound up in these lunar hallucinations, we had better do something about the dust situation on this planet. Lime dust, cement dust, catalyst particles, metallic oxides, synthetic chemicals and a host of other man-made dust particles are escaping to the atmosphere . . . in most cases, needlessly, and at considerable loss to the manufacturer.

The Ducon Company, through its extensive line of cyclones, scrubbers and filters, and through its competent engineering services, has solved a wide variety of dust recovery problems. We will be glad to solve yours.

ASK FOR BULLETIN A-9150.

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CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

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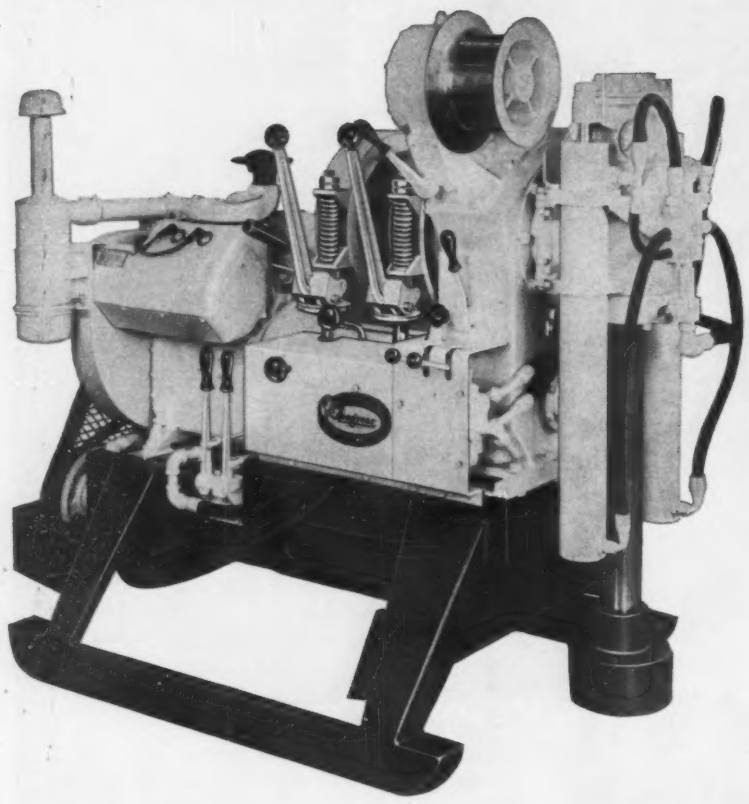
IT'S A FACT*



*NEW Longyear "38" Drill works anywhere, goes anywhere . . .

NOW LONGYEAR OFFERS YOU a compact, heavy-duty Diamond Drill that combines all the features drillers have asked for. The new Model "38" opens an era of operating efficiency on all kinds of mineral exploration jobs, blast hole drilling and site development work. Check the tested features below and see for yourself why the "38" is truly a modern drill built for modern drilling techniques.

- **NEW OPERATING EASE**—Control-Center Design provides "finger-tip" grouping of controls. No lost operating time or backaches from inefficient control arrangement.
- **NEW COMPACT SIZE**—Takes less space, transports easier with light-weight chassis breakdown. Low center of gravity gives greater safety whether used on skids, truck or trailer.
- **NEW VERSATILITY**—Available with angle hole mast, hydraulic retraction equipment, built-in wire line hoist, high-speed chuck runback and hydraulic or screw-feed swivel head. Gasoline, diesel, air or electric drive.
- **NEW DRILLING SPEEDS**—Rugged 3-inch head with 8 spindle speeds rotates large diameter rods. Special low-range for rotating casing or rock bitting. Capacity is full 2800 feet with AW rods.

For complete information, contact our nearest office.

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COMPANY LTD.
Tokyo, Japan

KCC announced that Western recently established a record for drilling and loading at the mine in August. The firm loaded 47,759 cubic yards of rock and believes this is a record for any rock job. Average for shovel was 1354 cubic yards an hour. Drilling record was 3436 ft in a day, or 76.4 ft every hour with 12¼ in. vertical rotary drill.

United States Smelting Refining & Mining Co. will reopen and develop the Butterfield lead and zinc mines in Lark-Bingham district of Utah as a result of an agreement with Kennecott Copper Corp.

Oscar A. Glaeser, vice president and general manager of operations for USSR&M, said work would start at once on driving of a 1450-ft tunnel from the Niagara (1400 ft) level of the U.S. section of the U.S. and Lark mines to a point under the Rough Wrestler shaft in the Butterfield mine.

Several diamond drill holes will be directed from the face of the tunnel into the lower workings of the Butterfield for dewatering purposes. Later, a raise will be driven to connect these workings with the tunnel.

The Butterfield formerly was entered through an adit in Butterfield Canyon above the town of Lark. The Rough Wrestler, an inside shaft, was used for ore haulage and materials. This shaft will play no role in U.S. plans, however. Ore will be taken out of the Butterfield through the new tunnel. The Butterfield is at the south end of the big Bingham copper pit. Mr. Glaeser estimates the driving of the new tunnel and raising will take about 28 months. When the mine is placed into production, it will employ about 50 men. The Butterfield has been worked for lead and zinc ores since the turn of the century by various operators. Last activity was in 1955 by Combined Metals Reduction Co. KCC acquired the mine a couple of years ago.

Utah Construction and Mining Co. will explore and develop the "Crypto" iron properties near Milford in western Utah controlled by Pinnacle Exploration Co.

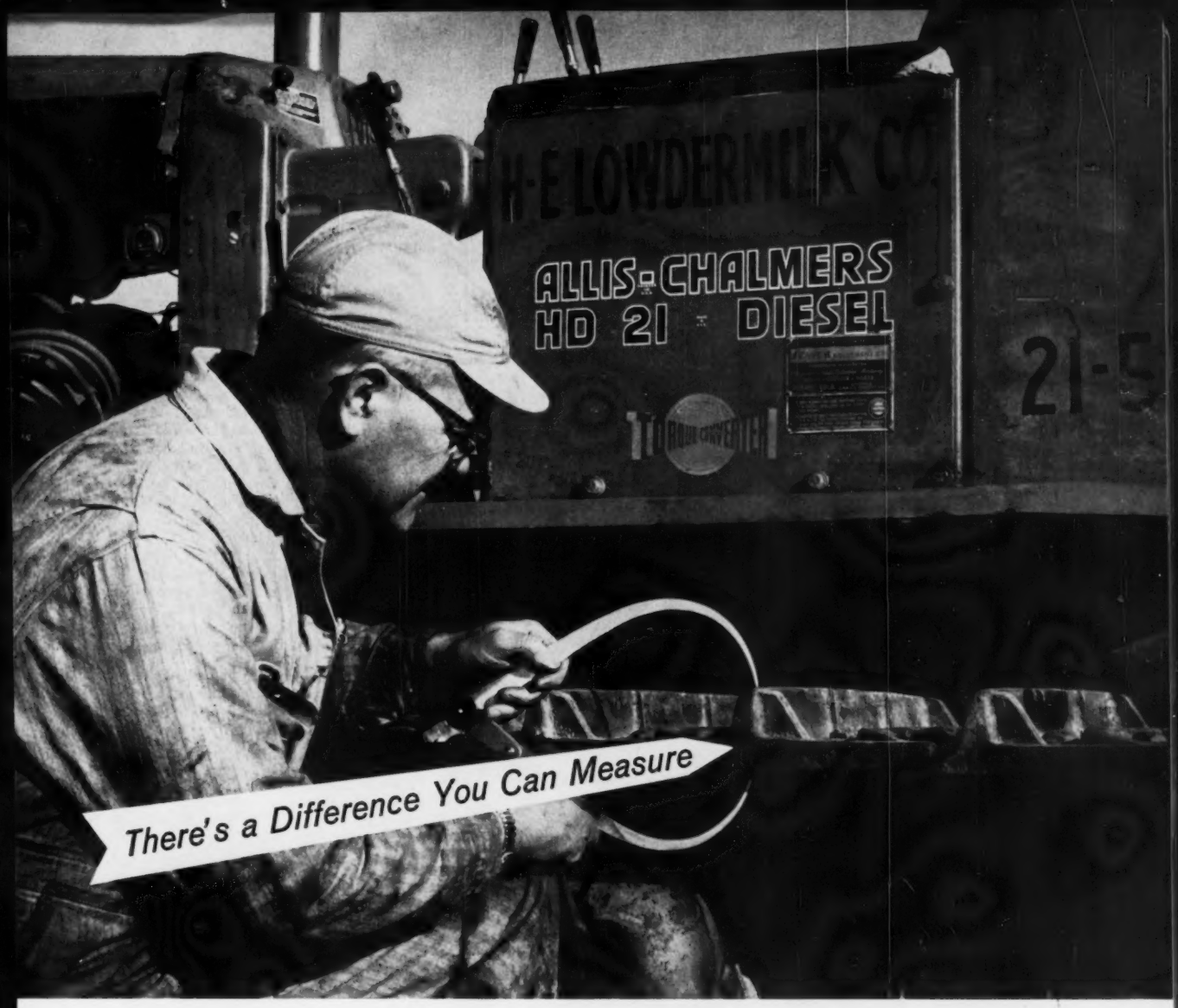
Pinnacle is 80% controlled by Callahan Mining Corp.

Callahan president Joseph T. Hall said that if U-C's core drilling program is successful, the western mining firm would have an option to buy the Crypto orebody.

Geological work the last three years on the prospect has been carried out by Prof. Mead LeRoy Johnson of Yale University's department of economic geology.

Directors of Beaver Mesa Uranium Co., Grand Junction, have declared first dividend in history of the firm—1.3 cents a share which will be paid on some 5 million shares outstanding.

Alan M. Simpson, president, also announced that the AEC had awarded allocation of 283,000 lb of uranium oxide in ore for period ended Dec. 31, 1966. This will result in a mining rate of about 50.000 tons annually from properties on Beaver Mesa on the Colorado-Utah line.



between AMSCO and other hard rock track shoes

There's *more than just a little difference* between Amsco manganese steel hard rock track shoes and other brands. Amsco shoes are built to take the impact and abrasion of the hardest rock.

H. E. Lowdermilk Construction Company, Englewood, Colorado, and Espanola, New Mexico, specializes in rock work where the going is rough and tough. Standard track shoes for one of their HD21's *wore out completely* in as little as 270 hours. Amsco 26″ manganese steel track shoes were specified and 302 hours later wear was only $\frac{3}{16}$″.

Mr. Howard Neff, mechanical superintendent for Lowdermilk, can actually measure the difference between the Amsco shoes and the ones they used to use. You will too. Just ask for Amsco shoes, available for all major makes of crawler tractors and in any special design you need.

Amsco makes a complete line of cast tractor parts, including end bits, replaceable sprocket rims, grouser bars and welding electrodes for buildup, repair and hardfacing.

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CHICAGO HEIGHTS, ILLINOIS

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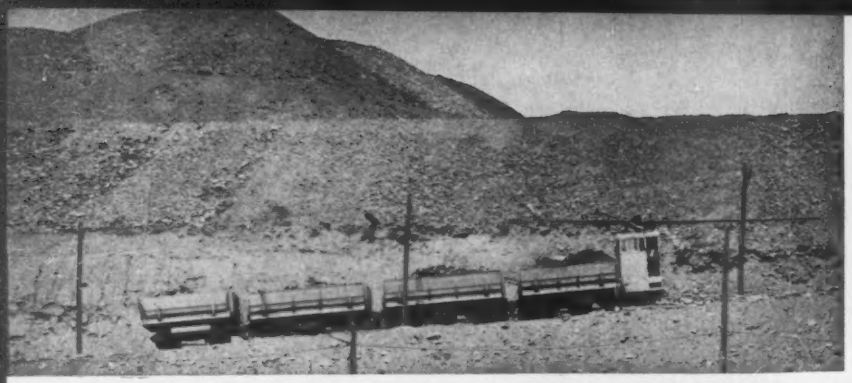
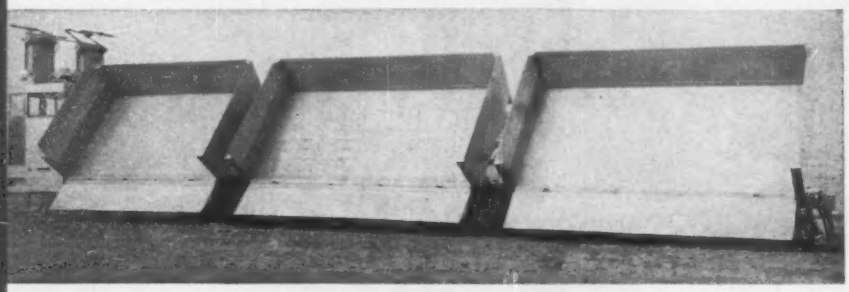


DIFFERENTIAL steep grade rail PACK TRAIN®

Up and down a 10% grade with DIFFERENTIAL ELECTRIC WHEELS for 13 years without an accident.

Uses trolley for fast climbing up 10% grade. Small auxiliary diesel-electric generator may be used for level track. With steel wheels on steel rails, tractive effort required is 5# per ton on level track, and 205# per ton up 10% grade.

Controlled speed with electric braking down 10% grade. Saves brake shoe and wheel wear. Capacities 1000 HP to 3000 HP.



PACK TRAIN uses rail all the way for lowest transportation cost. Dumps to either side all at once or one at a time.

250 HP DIFFERENTIAL two-way side dump WAGON TRAIN

A convenient way to unload. 45 ton highway train (15 tons in each wagon). 800 HP 90 ton off-highway train (30 tons in each wagon). Light weight trains haul heavy loads.

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Railway Air Dump Cars
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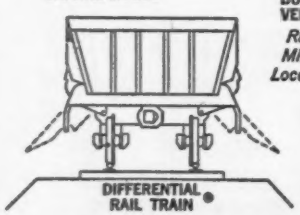

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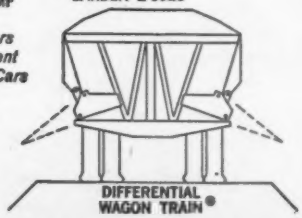


Rent Differential WAGON TRAINS from DIFCO, Findlay, Ohio

The allocation was given Beaver Mesa Uranium under the new "historical" definition affecting Uravan Mineral belt uranium-vanadium producers.

United Chemetrics of Beverly Hills, Calif., has apparently abandoned a program of producing artificial cryolite from fluorines received from phosphatic material.

United Chemetrics has the plant at Garfield up for sale.

A predecessor, United Heckathorn of Richmond, Calif., for the last couple of years had been producing the cryolite for sale as fluxing material to the Pacific Northwest aluminum industry.

Fluoride material was recovered from the processing steam of a high analysis phosphate fertilizer plant operated at Garfield by Western Phosphates, Inc., affiliate of Stauffer Chemical Co. and American Smelting & Refining Co. with Kennecott Copper Corp.

Michael Grayson of Beverly Hills recently purchased 51% of United Heckathorn, an insecticide chemicals producer. Name of the firm was changed to United Chemetrics and policy changes resulted in abandonment of the cryolite project.

New Park Mining Co. and Hecla Mining Co. have announced agreement by boards of directors of the two firms whereby Hecla will take over the Utah firm's Mayflower lead-silver-zinc-gold properties under a lease arrangement.

While the details were not announced, they do include a substantial annual payment by Hecla to New Park. And New Park would share in profits above mining costs and the costs of a 250 tpd mill which will be built.

The mill will have facilities for extracting gold values which have been increasing in recent months in the Pearl fissure in Mayflower mine.

New Park is one of the largest claim owners in the Park City district just east of Salt Lake City and the firm has included only the Mayflower mine in this transaction with Hecla.

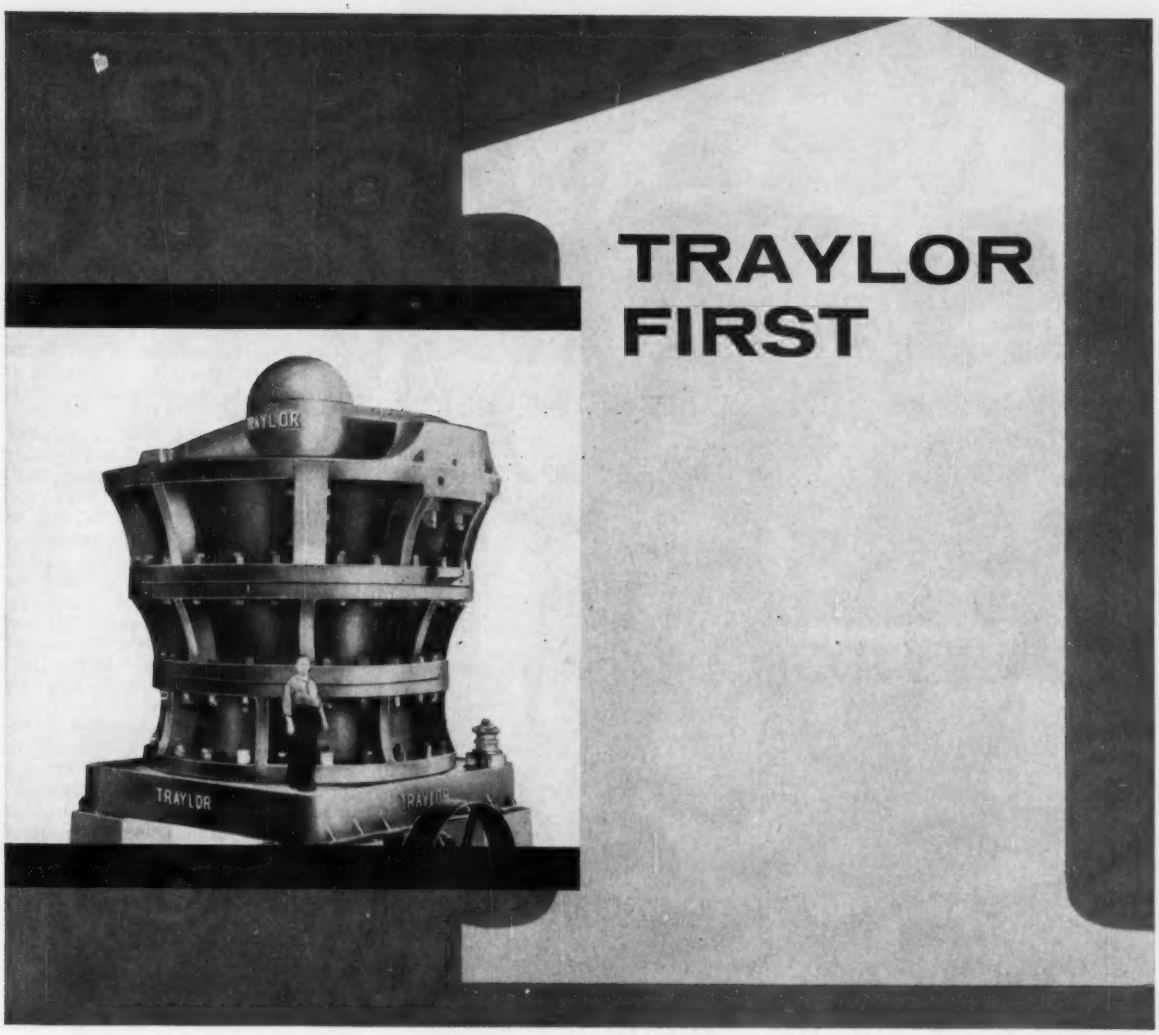
The two firms announced that the objective of the agreement is to expand production and exploration. New Park in recent years has completed facilities for added pumping of water and faster hoisting of ore.

For its part, Hecla will be taking over an operating mine which has produced millions of dollars of values since it was opened up about 30 years ago. Hecla's operations at the Radon uranium mine will continue for only a couple of more years on mining basis in the Big Indian district of Utah and the firm has been most active in investigating various mining properties in recent months in the Intermountain Area.

United Park City Mines Co., Park City district lead-silver-zinc producers—has reported a profit for a six months period ended June 30, 1961.

This is the first such profit for a six months term that the company has recorded in many years.

The firm's net was $12,907 before depletion, and was produced on a total income of $872,050. In first half of



Biggest primary gyratory crusher in 1919 and now . . . big reason why it pays to plan with Traylor in the changing 60's

Industry seeking a crusher of capacity bigger-than-ever turned to Traylor and got it . . . 42 years ago. The 60-inch primary gyratory first built by Traylor then is still in operation—along with two others purchased since by the same customer. It is still the standard by which "big" crushers are measured.

Why so important now? One obvious reason is, no one has a longer record of experience in this special field.

Of even greater importance: It's one of many important demonstrations of Traylor's being first with new and better equipment to meet changing production needs. You'll find many other examples throughout the industry—very likely right in your own plant. Do you use an all-welded kiln . . . a large ball mill, larger copper converter? All these are Traylor "firsts," too. Traylor's proved capacity to pioneer sound innovations in kilns, mills and crushers is enhanced today by expanded research capabilities and process know-how.

An impressive record of historic "first" . . . plus what it takes to stay first for so many years . . . that's why it pays to call on Traylor first when you're planning plant improvements for bigger profits tomorrow.

See Pit & Quarry Handbook for details and specifications

Traylor

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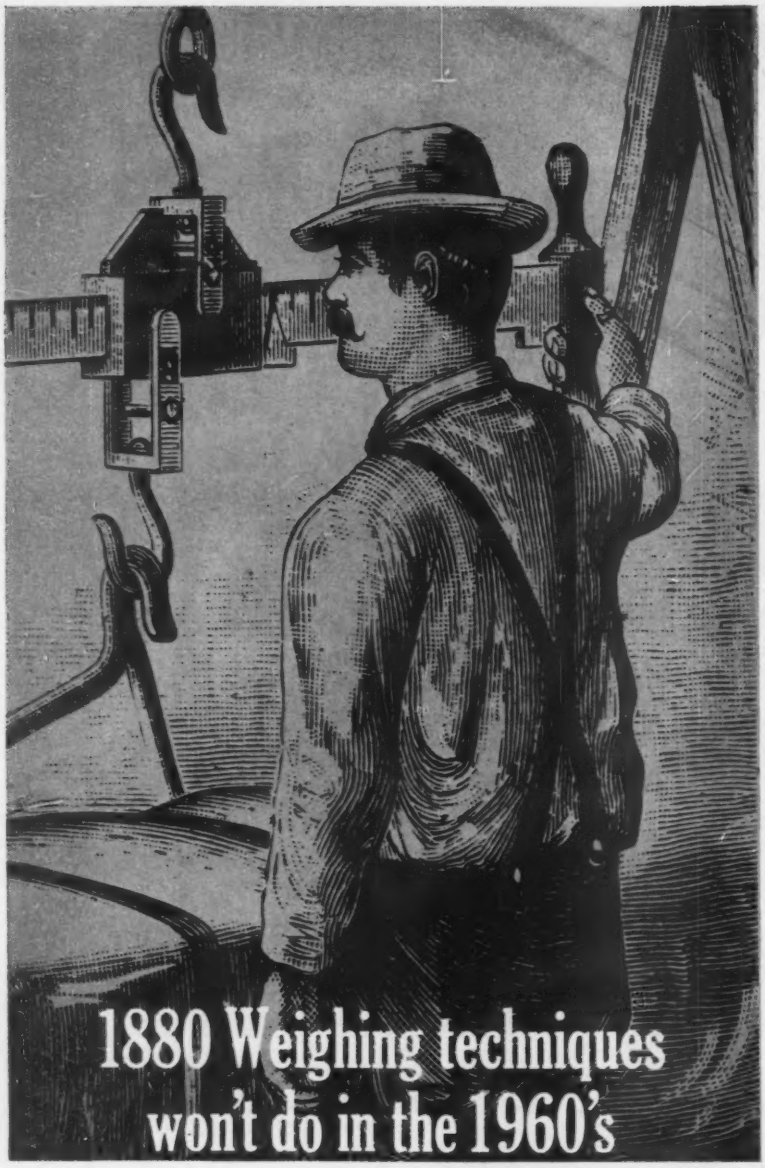
4184
TCA-12



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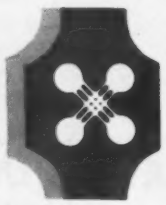

Weighing device with cover removed showing Pressductor cell

ASEA

1960, UPC had a loss of $78,756 before depletion on a total income of $1,020,733.

A spokesman for the mining firm said the small 1961 profit was attained as a result of "new efficiencies and economies and a slight increase in ore grade."

VIRGINIA

Core drilling to determine the economic feasibility of developing the low grade iron ore deposits in Giles County began in early September.

Directing the operation is Dr. Byron N. Cooper, head of the department of geological sciences at Virginia Polytechnic Institute.

The work is being done by Minerals Development Corp., which was recently formed by Norfolk and Western Railway. Roanoke Electric Steel Corp. and E. L. Keesling of Bramwell, W. Va., to seek the beginning of a new industry in the area.

The first cores are being taken on Pearis Mountain, south of Pearisburg, where the Clinton formation of iron bearing sandstone outcrops. Surface explorations have indicated that the sandstone should bear 30% or more of metallic iron.

The analysis of samples taken in the drilling will be the major factor in determining whether an ore industry can be developed in this area. Six weeks to two months should be required to complete the drilling, which is being done by the Cunningham Core Drilling and Grouting Co. of Salem, Va.

WYOMING

Alfred Ellerby of Lander, president of Vipont Mining Co., has urged the House Ways and Means Committee to hold hearings on a bill to permit development of gypsum deposits on the Wind River Indian Reservation in north central Wyoming.

The bill provides for use of Indian help at the pilot plant, a 10-year income tax exemption, and giving Shoshone and Arapahoe Indian tribes a substantial stock interest in the plant. A similar bill has also been introduced in the U.S. Senate.

Vipont plans to mine extensive gypsum deposits on the reservation, build a drying plant at Shoshoni and construct 35 miles of railroad from Shoshoni to the deposits.

Petrotomics Co. of Los Angeles has begun construction of its 500-tpd uranium mill and related facilities in the Shirley Basin area, 60 miles south of Casper.

The acid leach-solvent extraction mill is scheduled for completion in April 1962, according to George F. Getty II, president of Tidewater Oil Co., managing partner of Petrotomics.

Petrotomics is a partnership composed of Kerr-McGee Oil Industries, Skelly Oil Co., Getty Oil Co., and Tidewater.

Du Pont reports on

a new type of conveyor belt carcass

that sets new standards of performance

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Today, a new type of conveyor belting offers you cost-saving performance on the toughest jobs in industry. The reason is a fabric carcass made with strong reinforcements of "Dacron"* polyester fiber running the length of the belt.

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Improved durability—Impact resistance is excellent. The high strength of "Dacron" teams up with the strength and elasticity of nylon, the cross fiber, to sustain shock loads. "Dacron" resists stretch. This means lower growth of the belt in service—fewer take-ups.

Better flexing and troughing—Because of this high-strength carcass made with "Dacron", these belts can be thinner, permitting the use of smaller-diameter pulleys. They are more flexible, train better on idler rolls—resulting in less belt wander and edge wear. These belts have a better resistance to flex failure—an important long-life feature.

Troughing up to 45° is possible, compared to the usual 20°. This means belts can be narrower and lighter—and still carry larger loads. The result is reduced handling costs right down the line!

More for your belt dollar—It all adds up to superior performance and the economy of long service with fewer belt replacements, less down-time, lower maintenance costs. Make sure you ask about conveyor belts made with "Dacron" polyester fiber next time you order—get the most for your belt dollar!

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...more than 3 TIMES the stress placed on most operational belts

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Stearns-Roger Mfg. Co. of Denver has been awarded the contract for complete engineering, procurement and construction of the mill, slated to cost over $2 million, Getty said.

IN CANADA

NEW BRUNSWICK

Mount Pleasant Mines Ltd. has signed a new agreement with Kennco Explorations (Canada) Ltd., whereby Mount Pleasant takes over control of its 100-claim tin-molybdenite prospect in Charlotte County, and an additional 31 Kennco claims.

According to the terms of the new agreement, Mount Pleasant has the sole right to direct exploration and development, and to form a new company, at any time up to June 1966.

NEWFOUNDLAND

McNamara Construction Co. of Newfoundland Ltd., St. Johns, has been awarded a contract by the Flintkote Co. to develop facilities at its Flat Bay quarries in Newfoundland. The contract, between $1½- and $2-million, provides for completion of a six-mile long aerial conveyor from the existing quarries at Flat Bay to Turf Point and construction of pier facilities at Turf Point. A crushing building and related conveyor system also will be built at Flintkote's Flat Bay quarries. Work should be completed in about a year.

Flintkote earlier this year signed an agreement with the Province of Newfoundland permitting Flintkote under a 99-yr renewable lease rights to develop gypsum deposits in the Flat Bay area having proven reserves of 45-million tons of gypsum and subsequently to an area comprising nearly 3000 sq miles.

QUEBEC

Quebec Lithium Corp. has installed $500,000 worth of facilities for the production of lithium metal, according to Andre Beauchemin, secretary-treasurer and director. The company, Canada's sole lithium producer, will start its new production facilities in December. The plant is situated 20 miles north of Val D'or.

BRITISH COLUMBIA

Noranda Mines Ltd. has let contracts worth more than $3-million for plant construction and equipment at its Kennedy Lake division.

The awards are final steps in a program to start production of iron ore concentrates on a seven-year contract with Japanese steel interests that will gross nearly $50-million. Production will start in the first quarter of 1962.

Contract for construction of the crushing and milling plant has been awarded to John Laing and Son (Canada) Ltd. Through a subsidiary, Forward Installations Ltd., Laing's will also be responsible for the installation of all machinery required for processing the ore. The plant is expected to cost about $2.5-million.

Contract for construction of a wharf at Toquart Bay, at a cost of about $700,000 has been awarded to Pacific Pile-driving Co. Ltd. of Victoria. The wharf will be built to handle ships of 45,000 tons capacity.

The beneficiation plant is being designed and engineered by Wright Engineers Ltd. who will also supervise its construction.

The total cost of bringing the Kennedy Lake iron ore property into production is estimated at $6- to $7-million, including stripping of overburden for the open pit operation.

The beneficiation mill is designed to treat up to 4000 tpd of ore, using a magnetic separation process to improve its iron content from about 52 to 62%.

The contract calls for the supply of 700,000 ltpy of beneficated ore for seven years.

Since most iron ore contracts on the coast are at a price in the neighborhood of $10 a ton, the estimated value of this contract is close to $50-million.

Huestis Mining Corp. is investigating two new properties following abandonment of its Adams Lake project. The company chose the two from four new mining propositions present at a recent meeting.

Cash resources available to the company are approximately $100,000. Equipment is being held at Adams Lake.

Heavy equipment is engaged on site and road preparations at the Highland Valley property of Bethlehem Copper Corp. Ltd. The plan calls for completing all clearing of roads, water pipe lines and plant, including initial rock excavations in readiness for arrival of large construction crews next spring.

Western Mines has optioned the Lynx, Paramount and Price groups in the Buttle Lake area of Vancouver Island, consisting of 23 Crown-granted claims, six located and 36 recently staked.

Important indications have been found at three widely separated points on the property. At two points on the Price and Lynx groups, limited exposures by means of trenches and pits have revealed encouraging mineralization.

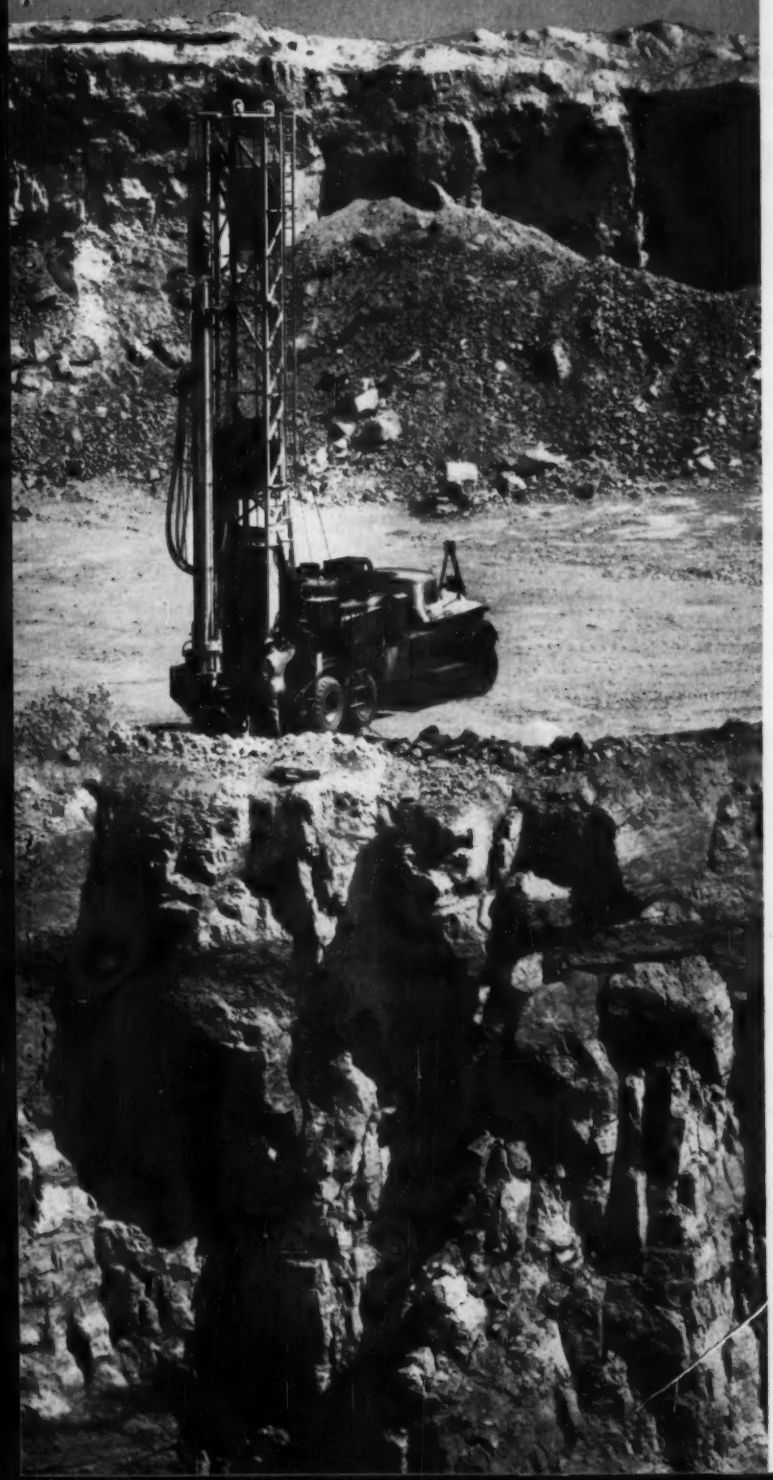
Diamond drilling the Paramount zone beneath a favorable surface exposure indicated a minimum deposit of 60,000 tons with gross value of $47 per ton in base and precious metals within a 200-ft length.

The old Musketeer Mine on Vancouver Island West Coast is being re-activated by a Vancouver group called Copper Town Mines Ltd. which will mine the property for gold, silver, lead and zinc.

A geological report says there are 16

with the

30-RS



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Once on the job, though, the difference *really* shows. The mast raises into position hydraulically. Three jacks plant their feet to provide a firm, level foundation. A hydraulic motor exerts any pull-down force you choose, from 0 to 30,000 lb, while another hydraulic drive provides any rotary speed to 110 rpm. With this combination of speed and pressure, you can drill 6¼- to 7⅞-in. holes faster than with any rig in its class — and you can drill continuously for more than 21 ft before adding new pipe.

Finally, the 30-RS lives up to the tradition of rugged stamina that has made the larger Bucyrus-Erie 40-R and 50-R Rotaries the most popular in their fields.

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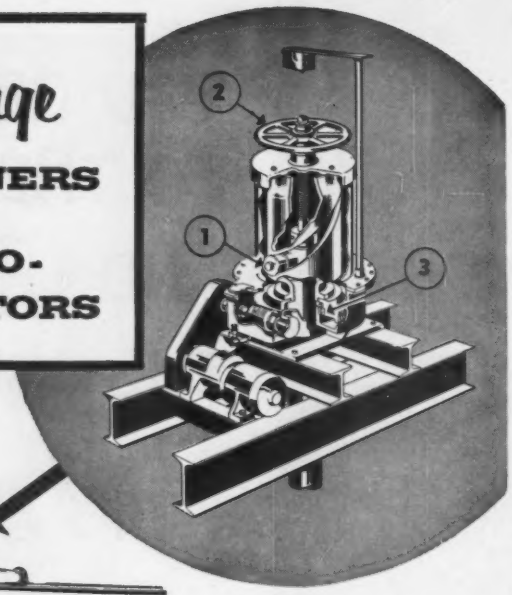
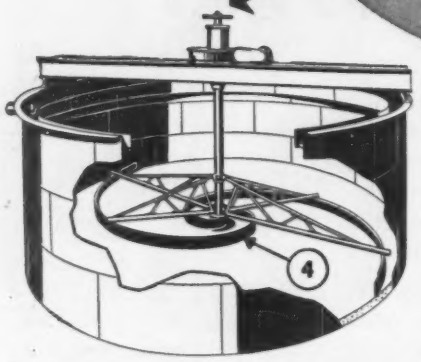
THICKENERS and HYDRO-SEPARATORS





1. "Auto-Raise" device.
2. Manual or power raise.
3. Replaceable ring-type ball bearing support.
4. Spiral rakes, and "froth rings."

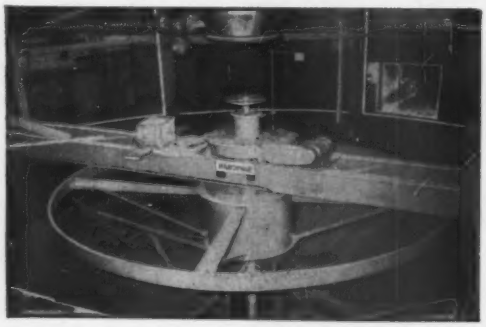
The higher the solids content in the thickener underflow, the lower the cost of filtering for subsequent processing or disposal.

The spiral rakes of the Hardinge Thickener compress the solids to maintain high density of underflow.

The "Auto - Raise" drive mechanism prevents overloading as the underflow is thickened.

Submerged parts may be supplied with rubber or lead covering or fabricated from wood or any metal available for structural parts.

Complete specifications upon request. Bulletin 31-D-1.



Also available are "froth rings" for froth-free overflow and superposed type tank construction (as shown above) for minimum floor space and building economy.

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known potential ore-bearing claims on the property, 18 miles from Tofino, but less than 50% of them have been explored. The report also says there are 3700 tons of proved ore containing 5956 oz gold and another 1000 possible tons with 1455 oz.

Rubymac Mines Ltd. has entered into an agreement with Bralorne Pioneer Mines Ltd. whereby the latter company has undertaken to explore Rubymac's 22-claim copper-gold prospect at Boundary Falls in the Greenwood mining division. Bralorne Pioneer already has a tractor with blade stripping the property and diamond drilling will follow as warranted by the results.

Sileurian Chieftain Mines Ltd. and Ardet Drilling Ltd. have completed a contract for minimum of 1500 ft of diamond drilling on the former's property near Alberni on Vancouver Island.

Depth testing is in area between two mineralized shear zones where surface work has indicated in excess of 11 somewhat parallel gold-silver-copper bearing quartz veins in an area on the face of a mountain with an approximate width of 650 ft and a vertical distance of 430 ft.

A four-hole drilling program last year to check one of these veins obtained three intersections of 2 ft each which gave assays of 0.40, 0.35 and 0.30 oz gold per ton.

Vancouver-based Utica Mines Ltd. will proceed to develop its lead-silver-gold property in Turkey as result of getting financing from a Toronto group sufficient for both its European and B.C. operations.

A ten-year ore supply is reported proven on the Turkey property. Development work is being continued with expectation of production by February.

ONTARIO

W. R. Lawson, vice-president and general manager of Sifto Salt Ltd., a subsidiary of Dominion Tar and Chemical Co. Ltd., has announced the start of a new 1800-ft shaft at the company's large rock salt mine at Goderich. The work is expected to be completed in two years at a cost of $1.6-million.

The new shaft, designed to increase safety and to provide additional ventilation, is the first part of a $3-million development which will include additional surface storage facilities and the installation of underground crushing and screening machinery. Capacity will ultimately be increased by more than 50%.

LATIN AMERICA

COSTA RICA

The first Krupp-Renn iron ore reduction plant to be built in the Western Hemisphere may be constructed in the

Republic of Costa Rica. The contracts for the feasibility studies and subsequent construction of the estimated $100-million installation have been entered into by Fried-Krupp of Essens, Germany and International Iron of Costa Rica Inc. of Houston, Texas.

Final details of the capacity of the plant are not available. The design and construction of the plant will be by Fried-Krupp Co. for International Iron of Costa Rica Inc., which is comprised of American, European and Costa Rican capital.

The plant will be located on the Pacific Coast where the deposits owned by International are located.

CHILE

Chile Exploration Co. has been authorized by the Ministry of Economics to expend $5,318,700 to bring into the country excavating and earth moving machinery to remove the overburden in the western section of the Chuquicamata mine and to build a regulating bin of 40,000 tons capacity as well as to construct 40 new houses for its employees. When the whole of this construction program is completed, Chuquicamata's output of copper will be increased by 16,500 tpy of copper. Of the above sum, $1,556,800 will be spent in salaries and wages and other services while $3,701,900 will go to import from the U.S. two churn drills, Mod. 50 T; one 8-yd electric shovel; 6 locomotives; 60 ore cars of 40 cu yds capacity each and some less important elements for the 40,000-ton bin.

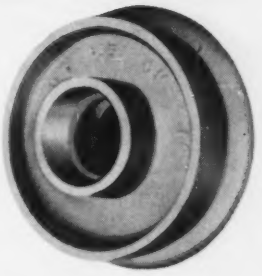
The National Mining Enterprise has already began buying copper ores for the new copper smelter being built at Ventanas north of the port of Valparaiso. These ores will be bought at the Agencies or depots at Combaralá, Illapel, Los Vilos, Cabildo and Tiltil. Though the prices paid for the ores will be the same as those that go to the Paipote smelter at Copiapó, the smaller freights deducted from the schedules because of shorter distances to Ventanas will mean higher values or prices for such ores. This may bring sellers anything between 10 and 40% better prices, depending on the Agency where the ores are sold. The Ventanas copper smelter is scheduled to go into operation at the end of 1962.

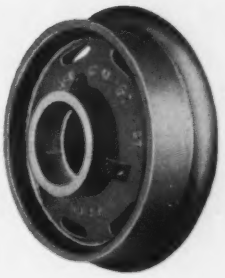
IN AFRICA

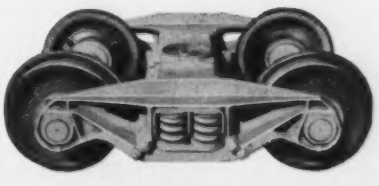
The Government of the Republic of Guinea has concluded an agreement with the Nederlandsche Handel Maatschappij (Netherlands Trading Society), the Banque de l'Indochine, the Hambros Bank Ltd., the Deutsche Bank, the Schweizerische Kreditanstalt, the Banque Rothschild and the Banque de Paris et des Pays Bas, combined in the Consafrique-Consortium, Luxemburg, with the object of undertaking the operation of important iron ore deposits

The tough ones come to **Card**

HIGH TONNAGE, LONG HAULS, POOR TRACK CONDITIONS ARE PROOF OF CARD WHEEL QUALITY







Long trains of ore cars each loaded with over 200 tons of rock have to keep moving. It takes good wheels for this service, often running in corrosive and abrasive water and muck. Card heat-treated semi-steel (chilled iron) wheels have been on the job for years in all types of underground mines particularly in the North and South American Continents. These Timken bearing wheels are easy pulling, true running and reliable for millions of ton-miles. Buy by the set or the hundred, for replacement or as original equipment to your haulage specifications.

CARD alloy steel wheels with hardened flange will equal or surpass the wear life of any comparable type of wheel with the added feature of greater economy. We invite your comparison.

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in the Nimba and Siandou mountains.

The deposits, with estimated finds of at least 200-million tons of iron ore containing over 65% Fe, are situated near the frontier of Liberia and the Ivory Coast Republic.

The bank-combine and the Government of the Republic of Guinea each take a 50% interest in the enterprise.

The Mozambique Government has announced that it will accept tenders for the concession of prospecting rights for copper and titaniferous magnetites on two demarcated areas in the Tete district. Preference considerations are wider industrialization to the best advantage of the province and biggest investment. The areas were surveyed by the country's Mining Department, E. J. Longyear and Zambeze Development Agency.

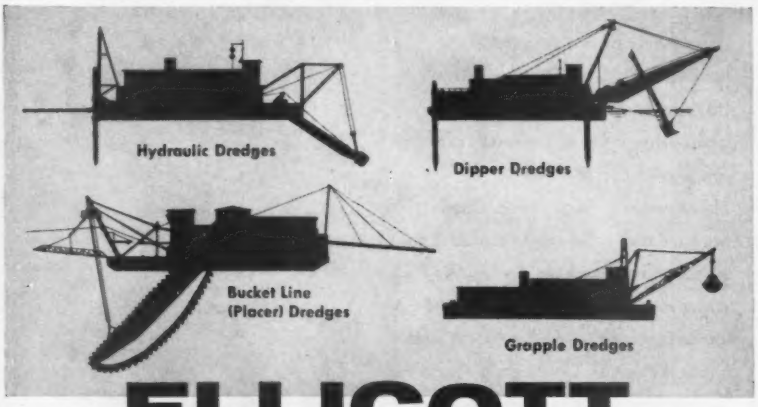
A tussle between rival South African backers to gain interest in the diamond claim of mountainous Basutoland, British Protectorate lying within South African Republic's borders is developing. The Paramount Chief of the Protectorate, Bereng Seeiso, has barred foreigners from pegging claims but this has failed to deter South African speculators. Light aircraft—the only kind that can reach this remote land—have been carrying many speculators ready to back local men.

The Basuto Royal Household is perturbed by the number of South Africans who are prepared to pay local tribesmen handsomely for the use of their names. Special bonuses are also being offered by the speculators to their partners.

Hundreds of Basuto have camped at the new diamond claim areas at Letsala-Drai in the Drakensberg waiting for the spring to start digging because now the area is deep in snow. The minor gem rush is said to be reminiscent of the Kimberley rush of earlier days—except that the diggers are Basuto instead of European and never before have natives indulged in such a venture.

Edward L. Bateman of Johannesburg has improved on the method of roof bolting in mines by developing accessories for tensioning bolts inserted into the roof to a correct and predetermined tension and so providing uniform tensioning on all roof bolts. This developed from a study of roof bolting made in America by P. S. Thiel of Batemans. About 100,000 such bolts are used in South African mines every month.

What may be an international record for borehole drilling has been achieved by Unidrilling Limited in the Western Transvaal. Using a Joy No. 50 diamond core drill, a depth of 3470 ft was reached in 26 days.



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Successors to the floating dredge business of the Bucyrus-Erie Company and the American Steel Dredge Co. Complete engineering, design and construction service.

3020

IN EUROPE

YUGOSLAVIA

An ancient zinc and lead mine at Novo Brdo near Prishtina in South Serbia which was closed only two years ago because it was thought to have exhausted its ore deposits, will be reopened soon as new and rich ore deposits have been discovered in the area.

The new deposits estimated at 6- to 7-million tons of ore containing 8 to 10% of zinc and lead, have also a large percentage of silver. Search of the area is continuing and other discoveries are expected. The reopened mine is only some 30 miles southeast of Yugoslavia's largest zinc-lead mine at Trepcha.

Incidentally, the Novo Brdo site is the oldest zinc-lead mine in the world. It was first exploited by the Romans when they came to this part of the world. In the Middle Ages, under the Serbian empire, it became so prosperous that a city of 40,000—bigger than Paris or London of those days—grew nearby and became famous for its mint. The city and the mine were completey destroyed when the Turks came in 1445. And the mine wasn't reopened until 1952, and then for only seven years. Now its revival seems to be assured.

IN INDIA

The State Trading Corp. has concluded

THIS IS MARION QUALITY

Slam the dipper of a mining excavator against a bank and begin to hoist through tons of unshot ore and strange things begin to happen. Cables whip taut, machine pivotal points are thrown under massive stresses and the entire unit is subjected to component-destroying vibration. It takes exceptional designed-in strength to resist such forces over the profit life of an excavator. Marion gives it to you. In almost 2" of solid, high-strength alloy deck plate for upper machinery support, in the 9-yard Type 181-M, for example. In machinery supporting members that are welded integral with the deck for absolute rigidity. In heat-treatment of the *entire* frame to relieve invisible weld stresses. In careful placement of components to spread operating stresses over a large area for additional stability. The long way around? Perhaps. But the safest—for machine and operator. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION

long-term agreements for the export of almost 94-million tons of iron-ore with Japan, Czechoslovakia, Poland, East Germany, Rumania and Yugoslavia mostly covering the period 1961-65 except for two long-term contracts with Japan which extend to 1980-81.

The deals relate to iron ore in the grade 65-60 to cover a total quantity of 93,695,000 tons and an additional 800,000 tons, also to be exported at India's option. This year's exports are to amount to 3.5-million tons, but these are to be stepped up if possible if the arrangements to move to ore from mines to ports are sufficiently improved.

The following are the particulars of the contracts:

Japan: 7.2-million tons, 1957-58 to 1961-62; 4.5 million tons, 1959-60 to 1961-62; 20 million tons, 1964-65 to 1973-74; 60 million tons, 1966-67 to 1980-81.

Czechoslovakia: 750,000 tons, 1960 to 1961; 200,000 tons 1960-61; 220,000 tons, 1960-61.

Poland: 600,000 tons, 1960-61.

East Germany: 300,000 tons, 1960 to 1963.

Rumania: 1.7-million tons, 1962 to 1966; 950,000 tons, 1962 to 1966.

Yugoslavia: 570,000 tons, 1961 to 1965; 615,000 tons, 1961 to 1965; 140,000 tons, 1961 to 1965.

There is the additional contract for supply of 800,000 tons to Rumania at seller's option.

The National Mineral Development Corp., a Government of India undertaking, which three years ago had sought Soviet technical assistance, announced a $3-million project for a large-scale prospecting of diamonds in the Panna region of Madhya Pradesh state (central India).

The Panna diamond mines, with an insignificant production, once were privately-owned. Today the Government is starting operations over a 27-mile region, of which a quarter sq mile is completely proved, to give India its own large diamond industry. It is proposed to exploit gravel and conglomerate and agglomeratic tuff to produce an estimated 40,000 to 50,000 carats by 1963, with the conglomerate expected to yield an annual 12,000 carats of which up to 65% is expected to be of the gem variety, the rest being industrial. In the tuff, a volcanic pipe will be drilled to a depth of 300 ft in the first instance.

The corporation also is in charge of exploiting a copper project and of developing the Kiriburu iron ore mines on the borders of the states of Bihar and Orissa (east India). According to one of its US consultants—the Western Knapp Engineering Co.—the Corporation should be able to develop an output of 10,000 tons or more of electrolytic copper out of its copper mines at Khetri.

The Hungarian Government has offered India a $30-million credit to develop aluminum and pharmaceutical industry. A Hungarian delegation, led by I. Gebefugi of the Planning Istitute of Hungarian Aluminium industry is in India to provide advice and select a suitable site for the proposed state-owned aluminum plant in the third Plan period. The Aluminium plant, with a rated annual output capacity of 25,000 tons, will cost about $40-million of which about $16-million will be foreign exchange expenditure to meet the import of plant and machinery. This amount is expected to be provided by the Hungarian Government out of its new credit offer. The remainder of the money will probably go to the pharmaceutical industry.

IN AUSTRALIA

The Australian Federal Govt. is envisaging various forms of assistance to mining projects aiming at the increase in Australian export potential. Further grants can be expected to State Instrumentalities to cover the substantial expenses in building roads and facilities for mining exploration and mining operations.

Large amounts of money will be invested in a new prospecting company, Group Ventures N.L., which will concentrate

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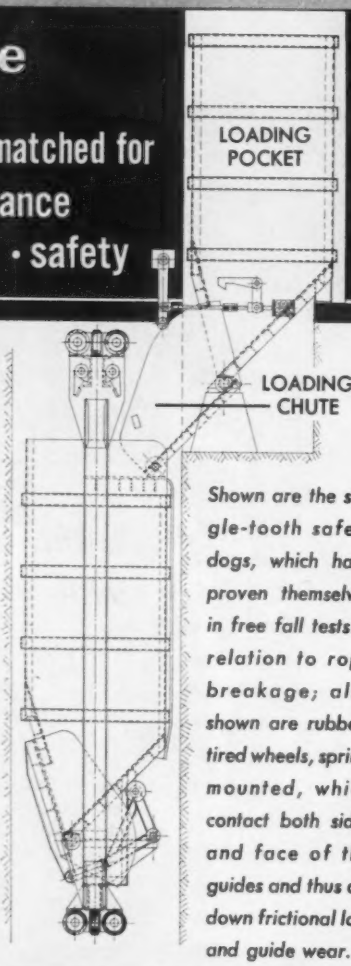

A 42-year record of outstanding service in handling coal, salt, potash, soda ash, aggregate, limestone, zinc, and other minerals and ores has proven the Connellsville Bottom Discharge Skip.

Each Skip is custom-built to your requirements . . . the skips mechanically open the loading chutes; the skips are filled and in turn, the departing skip closes the loading chute, toggle locking. Since the skip is of the fixed hopper type, both the bail and the lateral construction of the skip aid in maintaining its shape and structure. Write for information today on how you can increase the efficiency of your hoisting operation.

Shown are the single-tooth safety dogs, which have proven themselves in free fall tests in relation to rope breakage; also shown are rubber-tired wheels, spring mounted, which contact both sides and face of the guides and thus cut down frictional loss and guide wear.

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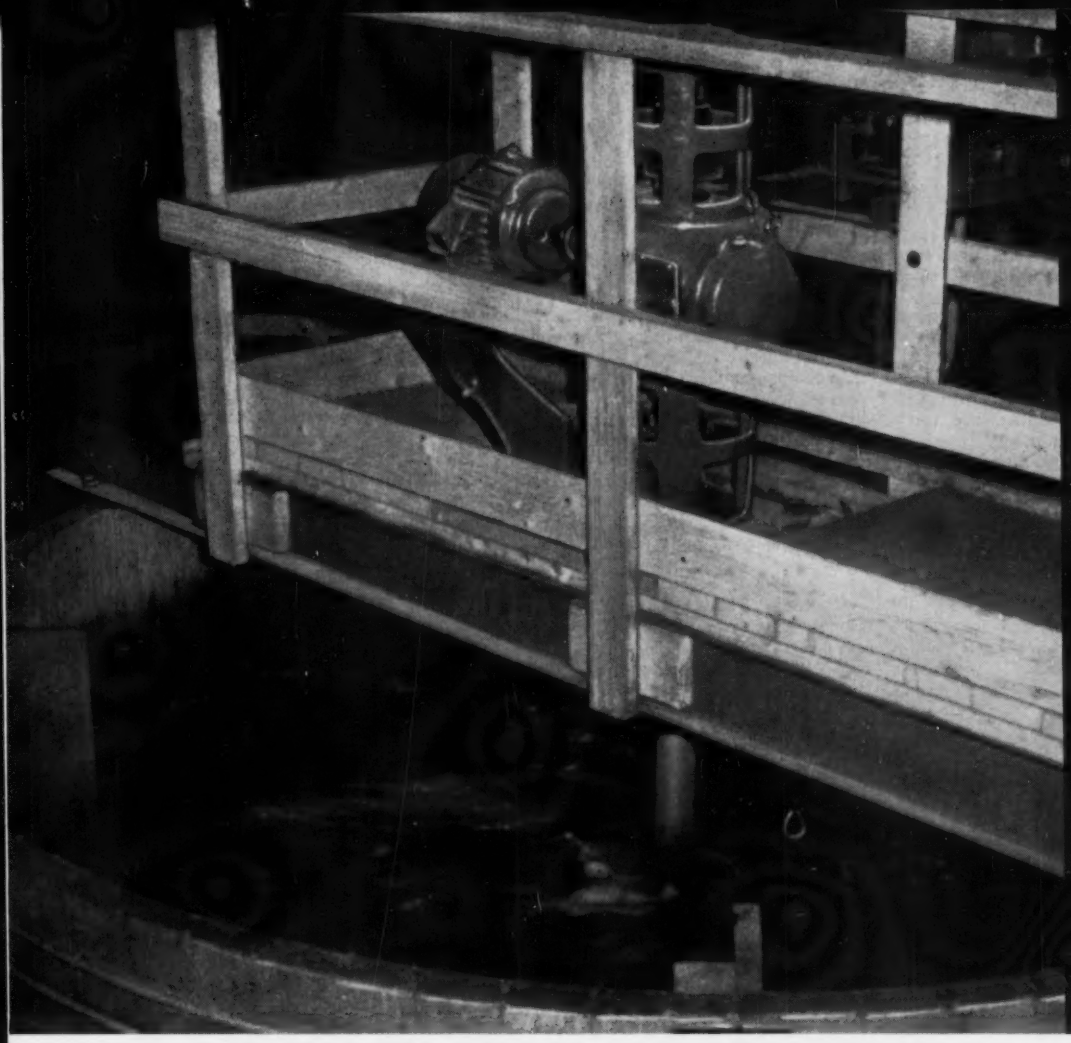

Fast Dispersal in 11-ft-dia., 12-ft-deep precipitation tanks is gained by using LIGHTNIN Mixers. For mixer details, request Catalog B-102.

Bicroft Uranium Mines Ltd., Bancroft, Ont.

How **uranium extraction** *gets a helping hand with mixing like this on the job*

In the precipitation tanks at this mine, fluid mixing has to walk a very narrow fence.

It must disperse alkali quickly through the ore, for uniform pH.

But it must also be gentle enough not to break down the delicate uranium oxide floc into a powder that could clog filters, cause stoppages and lower the efficiency of the entire extraction process.

The mixer you see here is one of several installed after a LIGHTNIN Mixer representative asked questions, took samples, and later returned with recommendations based on actual tests run in the laboratory. These LIGHTNIN Mixers are scale-ups of the mixers that solved the problem in the lab. They provide *precisely the balance of horsepower, speed and mixing action* to meet the critical requirements of the process.

Floc stays filterable. And pH quickly arrives at its desired uniformity.

Easy To Install

Installing these units was simple, because all LIGHTNIN Mixers are shipped fully assembled, factory-aligned, ready to install. Standard interchangeable components and easy access to all parts make maintenance easy. Aside from ordinary servicing, these mixers *have required no repairs or attention since going on the job 2½ years ago!*

Results Guaranteed

LIGHTNIN Mixers have many uses that can pay off for you. This mine also uses them to mix the magnesia slurry that controls pH when added to the precipitation tanks, and in making up barren eluate. You can also use them to blend ores in pulp form, speed chemical reactions, condition feed for flotation cells, or solve other fluid-mixing problems. Sizes range from ¼ to 500 HP, and *results are fully predictable, unconditionally guaranteed.*

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Blasting Vs. Crusher Costs at AMC

One paper that the mining industry has long awaited, finally emerged in "Effect of Fragmentation on Crusher Performance," by James Carr, assistant mine superintendent National Lead Co., Tahawus, N. Y. This paper proves conclusively that expenditures for closer drilling, and carefully planned explosives use can be offset by savings made in secondary blasting, lower cost loading, and increased crusher performance for other AMC coverage, see p 126.

Carr described the operations of the Sanford Hill open pit at Tahawus in detail. Daily production is about 8500 tons of magnetite-ilmenite ore and an equal amount of waste. All drilling is done by down-the-hole drills equipped to drill a 5½ to 6½-in. hole. Both 35 and 44-ft bench heights are used. Holes are drilled at a 10-deg. angle. Use of the angle hole reduced backbreak and oversize chunks of ore and toe problems were virtually eliminated. Fertilizer grade ammonium nitrate is used to load the holes.

The company undertook the intensified campaign to improve fragmentation because it was evident that crusher capacity would be overloaded in the near future. The following tables show clearly how increased expenditures for drilling and new explosive techniques were more than offset by lower over-all breaking costs, loading costs and crushing costs.

Table I
Crusher Production Statistics

	1957	1958	1959	1960
Tons per oper. hour	452	436	470	570
Tons per sched. hour	328	357	383	472
Mine controllable delay (percent of sched. time)				
Ore delivery delay	11.6	5.9	7.4	7.4
Jaw plug delay	6.1	7.7	6.6	3.3
Delay within crusher plant	9.6	4.4	4.7	6.5
Total delay	27.3	18.0	18.7	17.2

Table II
Comparative Drill, Breakage and Crusher Costs per Ton**

	1957	1958	1959	1960
Drilling	112	100	98	129
Blasting and dropball	114	100	100	90
Crushing	104	100	96	81
Total	107	100	97	90

**Base: 1958 unit costs = 100.

Table III
Comparative Crusher Performance and Cost**

	1957	1958	1959	1960
Comparative performance (tons per sched. hour)	92	100	107	132
Comparative cost per scheduled hour	95	100	103	107
Comparative cost per ton	104	100	96	81

**Base: 1958 cost and performance=100.

Table IV
Ore Shovel Performance and Cost

	1957	1958	1959	1960
Shovel performance (tons per sched. hour)	180	184	211	229
Comparative performance*	98	100	115	124
Comparative cost per hour*	100	100	102	109
Comparative cost per ton*	102	100	90	88

*Base: 1958 cost and performance=100.

on Northern Territory's tin and copper prospects.

The Asarco-controlled Mt. Isa Mines Ltd. has completed design and placed orders for equipment for a new $20-million mill. It will handle increased tonnages of ore from a new shaft and production will climb to 14,400 tpd. Completion target is 1964.

Aberfoyle Tin N.L.'s new tin field at Ardlethan will cost about $1.2-million to bring into production. The target of present operations is to prove 2-million tons of payable ore and establish a treatment plant with an approximate capacity of 1000 tpd. Open-cut mining is envisaged and an outside organization specializing in earthmoving will probably be given the contract for overburden removal. Annual tin production estimate is between 800 and 900 tons.

PHILIPPINES

Consolidated Mines, the Philippine major producer of refractory grade chromite ore has been awarded a contract for the exploration, development, and operation of the government's Zambales Mineral Reservation, which is situated practically adjacent to Benguet's present chrome operations at Consolidated Mines. Under its present contract with Consolidated Mines, Benguet will handle the new operations. From diamond drilling performed by the Bureau of Mines, about 600,000 tons of refractory chrome ore have been developed. The operating contract is for 25 years, renewable for another 25 years. Under its terms the government will share in 8% of the gross receipts.

The Philippine Iron Mines at Larap, Camarines Norte, reports that its new mechanical shiploading system is nearing completion. The conveyor-belt loading system will replace the old method of transporting ore to the company wharf by rail. Under the new system all ore will be taken by conveyor to the stockpile designed to hold 50,000 tons of ore. The system will be capable of delivering 600 tons of ore per hour. The total cost of the new facilities will exceed two million pesos. The same company is considering installation of an iron ore concentrator at Larap. This would permit upgrading large reserves of low grade ore. Atlantic, Gulf & Pacific Co. of Manila is general manager of the mine and A. Soriano & Co. are the consulting engineers.

A U.S. Export-Import Bank loan of $13-million for Marinduque Iron Mines Agents, has been approved by Government authorities. The money will be used to finance purchase in U.S. of machinery and equipment for the projected new processing plant at Sipalay, Occidental Negros. Operations are expected to start in 1963 and production annually is placed at 14,000 tons of fabricated copper products, 100,000 tons of fertilizer, and 5000 tons of zinc.

Charles A. Mitke, president of the Manila Mining Co. has announced a new gold find at the company's Agusan property in Mindanao. High grade ore containing 5½ oz of gold per ton was cut across 2½ ft in a tunnel. Cross cuts are being driven to determine the extent of the strike. The values are found in silicified andesite.

July production of Lepanto Consolidated, second largest copper producer in the Philippines, was estimated at 2,275,000 lb of copper and 3482 oz of gold, from milling 40,000 tons of 2.97% copper-gold ore. Concentrates are shipped to Tacoma.

The six month report of Atlas Consolidated showed improvement over the same period of 1960. Concentrates produced contained 20,879,000 lb of copper, valued at 14.6-million pesos. Stripping rate rose to 3.27 to one. Profits were 1.05 pesos per block share of stock, against 0.86 pesos in 1960. Current production is close to 4-million lb of copper a month.

NETHERLANDS NEW GUINEA

United States Steel with three Dutch enterprises, will jointly start explorations for minerals. Exploration for nickel and cobalt will start soon by the Pacific Nikkel Maatschappij N.V., which is formed by three Dutch enterprises, viz. Wm. H. Muller & Co. N.V., the Oost-Borneo-Maatschappij N.V. and the Nederlandsche Handel Maatschappij (Netherlands Trading Society), as a joint venture with the United States Steel and its associated Navigen Co. at Nassau

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A highway job -- where air hose attached to an Ingersoll-Rand Crawlmaster Drill is dragged over rough terrain covered with sharp rock -- hose has to be "more than ordinary" to stand such abuse.

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See HOSE in the Yellow Pages of your phone book for the name of your nearest Dayton Distributor.

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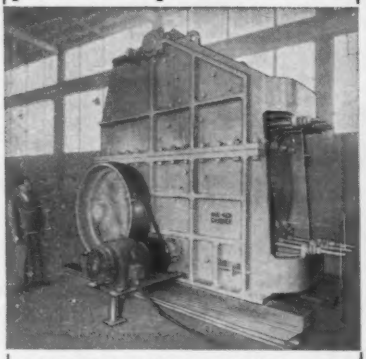

KUE-KEN JAW CRUSHER with exclusive "crushing without rubbing" action provides at least 5 times longer jaw plate life. Operates on far less power, has built-in lubrication system to eliminate costly downtime. Automatic flywheel release prevents damage from tramp iron. In 33 sizes from 12″ x 7″ to 48″ x 48″, Kue-Ken gives greater capacity than any other crusher.

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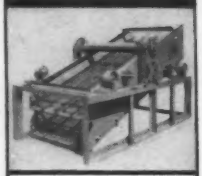

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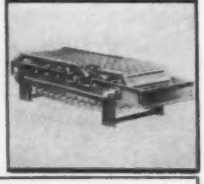

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(Bahama Islands). The search will start in Waigeo and surrounding islands (west of the "Vogelkop" peninsula) and in the Cyclops mountains near the town of Hollandia. Prospecting will be carried out by means of shallow drillings. The executive staff and the equipment will be sent from Holland.

Flotation—Denver

(Continued from p. 19)

Frank R. Milliken

Looking ahead, Milliken observed that with declining ore grades and higher costs we will have to have another breakthrough as significant as flotation. He expressed the hope that this would take place soon—perhaps in the field of using atomic devices to break rock; or in some new art of selective comminution based on knowledge of the bonding forces between minerals (i.e. shattering rock into component minerals particles rather than into particles containing mixed minerals).

From Weak to Stong

Among the papers that received considerable comment, was "Froth Flotation of Ion Exchange Resins," by Roshan Bhappu. The author illustrated one circuit in which a pulp containing metallic ions was circulated countercurrent with ion-exchange resins. The resins are floated off—starting at the last cell of the series, and circulated up-stage to the first cell in sequence. The pulp moved from the feed end successively to the final cell. Advantage of this system is the exposure of freshly conditioned ion resins to the weakest solutions in the final cell. Fully loaded resins are floated off of the first cell, and sent to the stripping and reconditioning stage for recirculation. Valuable experimental detail was reported by Bhappu. Dr. Gaudin complimented the author on the excellence of the work done. Metallurgists in the meeting said that ion exchange in combination with flotation may be one of the significant breakthroughs that F. R. Milliken said would be needed to keep metallurgical extraction going in the future.

Tops in Scholarship

Metallurgists at the meeting rated "Microscopy Applied to Mineral Dressing," by G. C. Amstutz, as one of the most scholarly papers presented. It could easily be regarded as a condensed textbook on the subject, starting with flowsheet of procedure, forms for tagging specimens, abbreviations for mineral constituents, forms for particle counting.

(Continued on p. 188)

E. H. ROSE of Pittsburgh, participated in post-paper discussions.

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geometric classification of basic intergrowth patterns of minerals, 60 line drawings and photomicrographs of intergrowths, and nine pages of references.

One of the great accomplishments in flotation history has been the solution of extremely difficult problems at the Sullivan Mill in British Columbia. Hence flotation experts considered "Treatment by Flotation of Sullivan Mine Ores," by R. W. Diamond, now retired, but until recent years an officer of Cominco, an outstanding contribution to flotation literature. Mr. Diamond acquired his early experience at Butte Mont., and Miami, Ariz., and with Minerals Separation Co., all three considered as mainsprings for the development of flotation in the U.S.

Mr. Diamond's paper described in great detail the test work that was done during the 1917-1923 period upon which the design of the Sullivan mill was based.

The extreme problems in concentrating Sullivan ore were indicated in Gaudin's book on flotation, 1932, where he said: ". . . in this ore the sulphides occur on an extremely fine state of division, resembling matte . . . Compared with ores of the Coeur d'Alene, Butte, and Salt Lake regions, the Sullivan ore is characterized by the much higher iron sulphide content. The ratios by volume of iron sulphide to galena and of iron sulphides to marmatite are about 100:10 and 100:20, respectively. For comparison it may be noted that the ratios of iron sulphides to galena and spahlerite are respectively 100:25 and 100:350 in the Butte ores, and 100:20 and 100:90 in the ores of the Salt Lake region. It may therefore be considered that the iron rejection problem is about twice as acute in the lead circuit, and four to fifteen times more acute in the zinc circuit of the Sullivan mill, than in the concentrators treating other complex lead-zinc-iron ores."

W. B. STEPHENSON, of Allen Sherman Hoff Pump, looks over Denver flotation program.

Papers and Authors Honoring Flotation

Flotation of Microorganisms
A. M. Gaudin, Massachusetts Institute of Technology

Future Flotation Research
D. W. McGlashan, Montana School of Mines

Froth Flotation of Ion-Exchange Resins and Its Application to Practice
Roshan B. Bhappu, New Mexico Institute Mining and Technology

New Developments and the Future of Flotation in Italy
Luigi Usoni, Director, National Council of Research, Rome, Italy

Measurement of Zeta Potentials by Radial Streaming Method
Norman Street and P. R. Stewart, University of Illinois

An Investigation of the Mechanism of Selective Salt Flotation and Discussion of Underlying Theories
Arno Singewald, Wintershall AKG, Frankfurt, Germany

Hydrolytic and Ion Pair Adsorption Models for Collectors in Flotation
Melvin A. Cook, University of Utah

Aspects of Flotation Cell Design
A. Jowett and G. V. West, Mining Dept., The University, Leeds, England

The Analysis of Flotation Test Data
C. C. Dell, Mining Dept., The University, Leeds, England

The Evaluation of Flotation Performance
C. C. Dell, Mining Dept., The University, Leeds, England

(Continued on p. 190)

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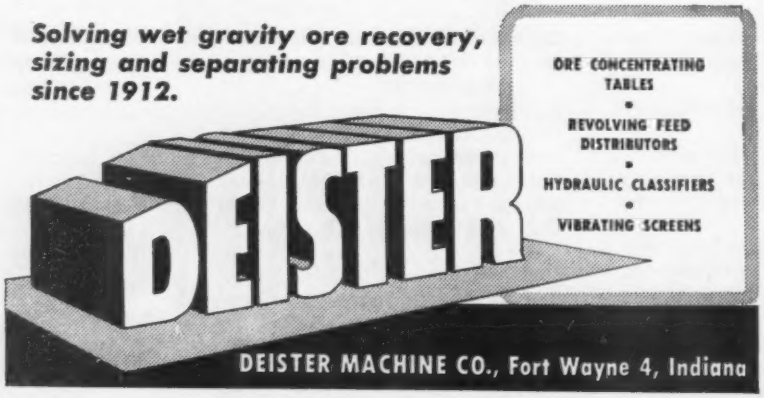

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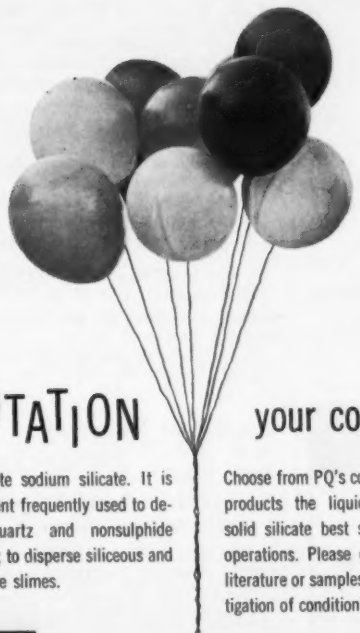

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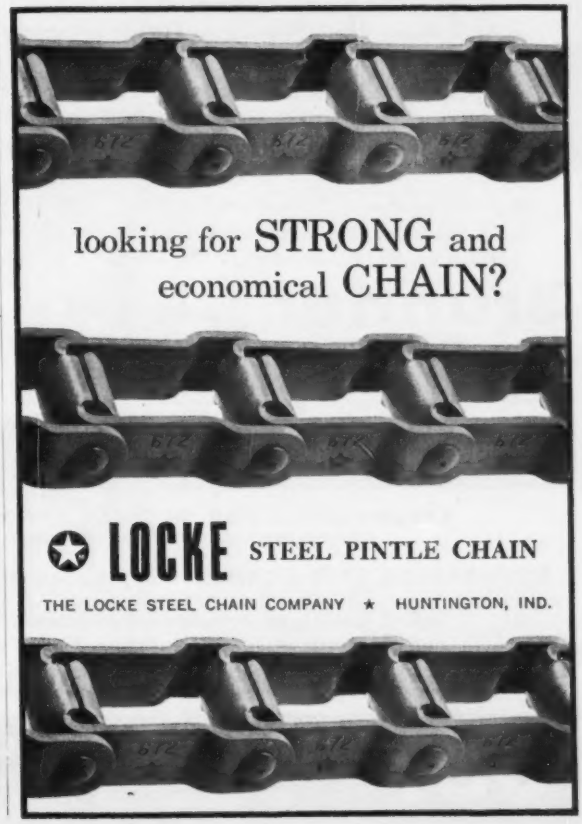

Dezincing of Lead Concentrates at the Sullivan Concentrator
H. J. Chalmers, Consolidated Mining and Smelting Co., Canada

Recent Research and Development in Flotation of Oxidized Ore of Copper, Lead, and Zinc
M. Rey, Ecole National Superieure des Mines, Paris; P. de Merre, Research Laboratories, Union Miniere du Haut Katanga; R. Mancuso, Societa Mineraria e Metallurgica di Pertusola, Sardine; V. Formanek, Penarroya Department, Minerais and Metaux Laboratory

Extraction of Molybdenite from Copper Flotation Products
R. W. Hernlund, Pima Mining Co., Tucson, Arizona

New Facets in Flotation at Climax
R. Cuthbertson, Climax Molybdenum Co., Climax, Colo.

Flotation's Early Years
E. J. Pryor, University of London, London, England

Flotation Aids Cyanidation of Pachuca Ores
R. R. Bryan, Cia del Real de Monte y Pachuca, Pachuca, Mexico

The Leach-Precipitation Flotation Method of Concentration at Miami Copper Co.
J. J. Bean, Miami Copper Co., Miami, Arizona

Design of Flotation Section
O. W. Walvoord, O. W. Walvoord, Inc., Denver, Colo.

Frothing Characteristics of Alcohol Solutions
Hiroshi Kuno, M. E. Volin, M. G. Berry, Michigan College of Mining and Technology, Houghton, Michigan

Attritioning and Conditioning in Flotation of Spodumene Ore
N. Arbiter, Henry Krumb School of Mines, Columbia University; J. R. Abshier, Texas Gulf Sulpher Co.; and J. W. Crawford, Texas Gulf Sulpher Co.

Present Flotation Practice in the Coal Industry in Great Britain
John L. Lewis, Unifloc, Ltd., Swansea, Wales

Phosphate Flotation
I. M. LeBaron, International Minerals and Chemical Corp., Skokie, Ill.

Anionic vs Cationic Flotation of Potash
H. N. Clark and J. S. Reiter, Potash Co. of America, Carlsbad, N. M.

Mechanics and Control in Coal Flotation
W. E. Bearce, Hanna Coal Co.

Iron Ore Flotation
Louis J. Erck, Cleveland-Cliffs Iron Co.

The Development of Flotation for the Treatment of Lead-Silver-Zinc Ores at Broken Hill, New South Wales, Australia
T. A. Read, retired, formerly Chief metallurgist, Broken Hill South, Ltd., Australia; C. W. Thomas, The Zinc Corp. Ltd., Australia; K. P. W. Parsons, New Broken Hill Consolidated, Ltd., Australia

Microscopy Applied to Mineral Dressing
G. C. Amstutz, Missouri School of Mines and Metallurgy, Rolla, Missouri

Technical Efficiency of Concentration Operations
J. R. Stevens, Chemical Engineering Div., A.E.R.E., Harwell, Berks, England; D. N. Collins, Warren Springs Laboratory, Stevenage, Herts, England

Development of the Treatment by Flotation of the Ore of the Sullivan Mines
R. W. Diamond, retired, formerly Director, Consolidated Mining and Smelting Co., Trail, B.C., Canada

Analysis on the Flotation Performance of Iron Ores
J. W. H. Chi, Jones and Laughlin Steel Corp.

Condensed Sodium Phosphates in Ore Benefication
John W. Lyons and R. P. Langguth, Monsanto Chemical Co.

A Method for Predicting Flotation Concentrate Quality
W. E. Horst and G. W. Mitchell, Foote Mineral Co.

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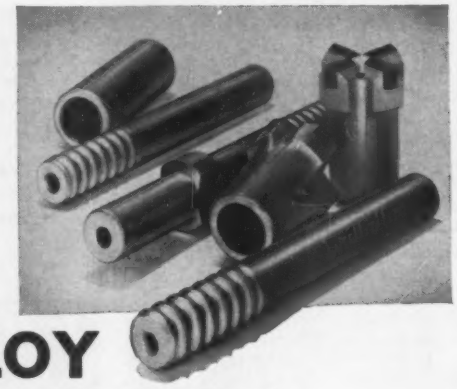

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Northwest Resources

(Continued from p. 92)

showings of considerable promise in Southern Yukon—involving especially silver values, sparked by recent events pointing to higher silver prices in the future.

Undoubtedly the biggest mining event in the near future in the Canadian Northwest is the probable development of the huge Pine Point zinc-lead deposit on the south shore of Great Slave Lake, outside the Battelle study area. Pine Point Mines (controlled by Cominco) is committed to open up the deposit and build a mill

to ship a minimum of 215,000 tons of concentrate annually for 10 years over a new railroad to be built from Pine Point some 440 miles southward to a junction with the present rail network at Grimshaw, Alberta. Concentrates will be smelted at Trail.

Also not shown in Fig. 1 or Table I is the Lost River tin deposit near the tip of Seward Peninsula, about 100 miles Northwest of Nome. This is because the limited known reserves (perhaps 6000 tons of contained tin) would require a price of over $1.35 per lb for economic mining. If the price of tin keeps advancing, operation of this mine might be resumed (it was operated for Government account from 1951-55 at a cost per lb of recovered tin of about $1.35) for several years—possibly longer if ore reserves are extended by mining and further exploration.

Of much interest and value to exploration work in Alaska are four maps showing occurrences of 13 metals, issued by the USGS in 1960,[2] including references to their descriptions in government reports. Twenhofel gave an excellent review of the mineral potential of Alaska[3]; Bostock did the same for Yukon Territory[4]; and Smitheringale et al. covered the same for northern British Columbia.[5]

High exploration, development, construction, and operating costs, notably in Alaska, serve as a deterrent to mineral developments. However, improved transportation—especially pioneering roads—would help a lot, and plans or programs are under way to push more of these. Although some mining companies that have explored the area rather extensively feel quite discouraged with the results, others are highly optimistic. There is general agreement that the area comprises good "hunting ground" for important new discoveries. Unsettled conditions in many foreign areas should serve as a spur to explore and develop areas in Northwest North America where the business climate is highly favorable.

1a "Yukon and N.W.T. Exploration Work Rapidly Expanding," THE NORTHERN MINER, August 31, 1961, p 10.

2 Mineral Investigations Resource Maps, compiled by E. H. Cobb, USGS, 1960.
(a) Chromite, Cobalt, Nickel, and Platinum Occurrences in Alaska, Map MR-8;
(b) Copper, Lead, and Zinc Occurrences in Alaska, Map MR-9;
(c) Molybdenum, Tin, and Tungsten Occurrences in Alaska, Map MR-10; and
(d) Antimony, Bismuth, and Mercury Occurrences in Alaska, Map MR-11.

3 Twenhofel, U.S., "Potential Alaskan Mineral Resources for Proposed Electrochemical and Electrometallurgical Industries in the Upper Lynn Canal Area, Alaska", USGS, Circular 252 (1953).

4 Bostock, H. S., "Potential Mineral Resources of Yukon Territory", Geol. Surv. of Canada, Paper 50-14 (Revised Edition) (1953).

5 Smitheringale, W. V., Bacon, W. R., Scott, J. S., Cannon, D. M., Smith, A., and Holland, S. S., "The Mineral Resources of Northern British Columbia", Proceedings of Twelfth British Columbia Natural Resources Conference, Harrison Hot Springs, Nov. 19, 1959.

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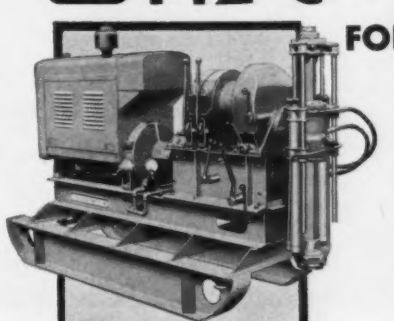

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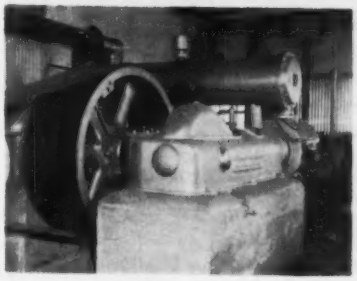

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1—100 HP. Denver Engineering, 1 drum, 440 V.
1—150 HP. Vulcan, 1 drum, new.
1—250 HP. Allis Chalmers, 1 drum, 2200 V.
1—600 HP. Vulcan, 2 drum, 2200 V.
1—675 HP. Vulcan, 2 drum, 2200 V.
1—150 HP. Vulcan Wilkes Barre, 2-drum, 24,000 lb.

HOISTS, SLUSHERS
3—CF-211 Sullivan, 2 drum, 50 HP.
1—20 NN2C I-R 2 drum, 20 HP.
1—BF212 Sullivan, 2 drum, 20 HP.
13—ASNNOH I-R, 2 drum, air.
3—FF-211 Joy, 2 drum, 15 HP.
1—20 MLAD I-R, 2 drum, 20 HP.
1—AF-211 Sullivan, 2 drum, 10 HP.
3—FF-211 Joy, 2 drum, 15 HP.
3—15 NM2F I-R, 2 drum, 15 HP.
1—15 NN1F I-R, 2 drum, 15 HP.
3—20 NM3C I-R, 2 drum, 20 HP.
7—30 NN3D I-R, 2 drum, 30 HP.
1—N-311 Sullivan, 3 drum, 25 HP.
1—BF-312 Sullivan, 3 drum, 20 HP.
1—BFA-312 Sullivan, 3 drum, 30 HP.
5—CF312 Joy, 3 drum, 60 HP.

HOISTS, TUGGERS
15—HU Ingersoll-Rand, air.
7—D6U Ingersoll-Rand, air.
10—HB Gardner-Denver, air.
1—DF-113 Joy, 7½ HP. electric.
8—L-111 Joy, piston air.

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4—1½ Ton Mancha Little Trammers, 24" ga.
1—8 Ton Plymouth Diesel, 24" ga.
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1—10'x48" Hardinge, ball, 400 HP.
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1—86 Marcy, Ball, 225 HP.
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6—12-B Eimco, 24" ga.
4—No. 21 Eimco, 24" ga.
1—HL-3 Sullivan, 18" ga.
1—No. 21 Eimco, Incline, 42" ga.
2—Model 630 Eimco.

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